US Army Corps
of Engineers®
Walla Walla District

FINAL

Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

Appendix Q
Tribal Consultation and Coordination

Appendix R
Historical Perspectives

Appendix T
Clean Water Act, Section 404(b)(1) Evaluation

February
2002

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13. ABSTRACT *(Maximum 200 words)*
This Final Feasibility Report/Environmental Impact Statement (RE/EIS) and its 21 appendices document the results of a comprehensive analysis of the four dams on the lower Snake River (collectively called the Lower Snake River Project) and their effects on four lower Snake River salmon and steelhead stocks listed for protection under the Endangered Species Act (ESA). The U.S. Army Corps of Engineers (Corps), along with Bonneville Power Agency (BPA), U. S. Environmental Protection Agency (EPA), and U. S. Bureau of Reclamation (BOR) as cooperating agencies, analyzed four alternatives to evaluate the best way to improve juvenile salmon migration through Lower Snake River Project. The Final FR/EIS includes the best available information on the biological effectiveness, engineering components, costs, economic effects, and other environmental effects associated with the four alternatives: Alternative 1-Existing Conditions, Alternative 2-Maximum Transport of Juvenile Salmon, Alternative 3-Major System Improvements (Adaptive Migration), and Alternative 4-Dam Breaching. In the Final FR/EIS, the Corps identifies Alternative 3-Major System Improvements (Adaptive Migration) as the recommended plan (preferred alternative) and explains the process for selecting that alternative.

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FEASIBILITY STUDY DOCUMENTATION

	Document Title
Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement	
Appendix A (bound with B)	Anadromous Fish Modeling
Appendix B (bound with A)	Resident Fish
Appendix C	Water Quality
Appendix D	Natural River Drawdown Engineering
Appendix E	Existing Systems and Major System Improvements Engineering
Appendix F (bound with G, H)	Hydrology/Hydraulics and Sedimentation
Appendix G (bound with F, H)	Hydroregulations
Appendix H (bound with F, G)	Fluvial Geomorphology
Appendix I	Economics
Appendix J	Plan Formulation
Appendix K	Real Estate
Appendix L (bound with M)	Lower Snake River Mitigation History and Status
Appendix M (bound with L)	Fish and Wildlife Coordination Act Report
Appendix N (bound with O, P)	Cultural Resources
Appendix O (bound with N, P)	Public Outreach Program
Appendix P (bound with N, O)	Air Quality
Appendix Q (bound with R, T)	Tribal Consultation and Coordination
Appendix R (bound with Q, T)	Historical Perspectives
Appendix S*	Snake River Maps
Appendix T (bound with R, Q)	Clean Water Act, Section 404(b)(1) Evaluation
Appendix U	Response to Public Comments

*Appendix S, Lower Snake River Maps, is bound separately (out of order) to accommodate a special 11 x 17 format.

The documents listed above, as well as supporting technical reports and other study information, are available on our website at http://www.nww.usace.army.mil/lsr. Copies of these documents are also available for public review at various city, county, and regional libraries.

STUDY OVERVIEW

Purpose and Need

Between 1991 and 1997, due to declines in abundance, the National Marine Fisheries Service (NMFS) made the following listings of Snake River salmon or steelhead under the Endangered Species Act (ESA) as amended:

- sockeye salmon (listed as endangered in 1991)
- spring/summer chinook salmon (listed as threatened in 1992)
- fall chinook salmon (listed as threatened in 1992)
- steelhead (listed as threatened in 1997).

In 1995, NMFS issued a Biological Opinion on operations of the Federal Columbia River Power System (FCRPS). Additional opinions were issued in 1998 and 2000. The Biological Opinions established measures to halt and reverse the declines of ESA-listed species. This created the need to evaluate the feasibility, design, and engineering work for these measures.

The Corps implemented a study (after NMFS' Biological Opinion in 1995) of alternatives associated with lower Snake River dams and reservoirs. This study was named the Lower Snake River Juvenile Salmon Migration Feasibility Study (Feasibility Study). The specific purpose and need of the Feasibility Study is to evaluate and screen structural alternatives that may increase survival of juvenile anadromous fish through the Lower Snake River Project (which includes the four lowermost dams operated by the Corps on the Snake River—Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams) and assist in their recovery.

Development of Alternatives

The Corps' response to the 1995 Biological Opinion and, ultimately, this Feasibility Study, evolved from a System Configuration Study (SCS) initiated in 1991. The SCS was undertaken to evaluate the technical, environmental, and economic effects of potential modifications to the configuration of Federal dams and reservoirs on the Snake and Columbia Rivers to improve survival rates for anadromous salmonids.

The SCS was conducted in two phases. Phase I was completed in June 1995. This phase was a reconnaissance-level assessment of multiple concepts including drawdown, upstream collection, additional reservoir storage, migratory canal, and other alternatives for improving conditions for anadromous salmonid migration.

The Corps completed a Phase II interim report on the Feasibility Study in December 1996. The report evaluated the feasibility of drawdown to natural river levels, spillway crest, and other improvements to existing fish passage facilities.

Based in part on a screening of actions conducted for the Phase I report and the Phase II interim report, the study now focuses on four courses of action:

- Existing Conditions
- Maximum Transport of Juvenile Salmon

- Major System Improvements
- Dam Breaching.

The results of these evaluations are presented in the combined Feasibility Report (FR) and Environmental Impact Statement (EIS). The FR/EIS provides the support for recommendations that will be made regarding decisions on future actions on the Lower Snake River Project for passage of juvenile salmonids. This appendix is a part of the FR/EIS.

Geographic Scope

The geographic area covered by the FR/EIS generally encompasses the 140-mile long lower Snake River reach between Lewiston, Idaho and the Tri-Cities in Washington. The study area does slightly vary by resource area in the FR/EIS because the affected resources have widely varying spatial characteristics throughout the lower Snake River system. For example, socioeconomic effects of a permanent drawdown could be felt throughout the whole Columbia River Basin region with the most effects taking place in the counties of southwest Washington. In contrast, effects on vegetation along the reservoirs would be confined to much smaller areas.

Identification of Alternatives

Since 1995, numerous alternatives have been identified and evaluated. Over time, the alternatives have been assigned numbers and letters that serve as unique identifiers. However, different study groups have sometimes used slightly different numbering or lettering schemes and this has led to some confusion when viewing all the work products prepared during this long period. The primary alternatives that are carried forward in the FR/EIS currently involve the following four major courses of action:

Alternative Name	PATH[1/] Number	Corps Number	FR/EIS Number
Existing Conditions	A-1	A-1	1
Maximum Transport of Juvenile Salmon	A-2	A-2a	2
Major System Improvements	A-2'	A-2d	3
Dam Breaching	A-3	A-3a	4

[1/] Plan for Analyzing and Testing Hypotheses

Summary of Alternatives

The **Existing Conditions Alternative** consists of continuing the fish passage facilities and project operations that were in place or under development at the time this Feasibility Study was initiated. The existing programs and plans underway would continue unless modified through future actions. Project operations include fish hatcheries and Habitat Management Units (HMUs) under the Lower Snake River Fish and Wildlife Compensation Plan (Comp Plan), recreation facilities, power generation, navigation, and irrigation. Adult and juvenile fish passage facilities would continue to operate.

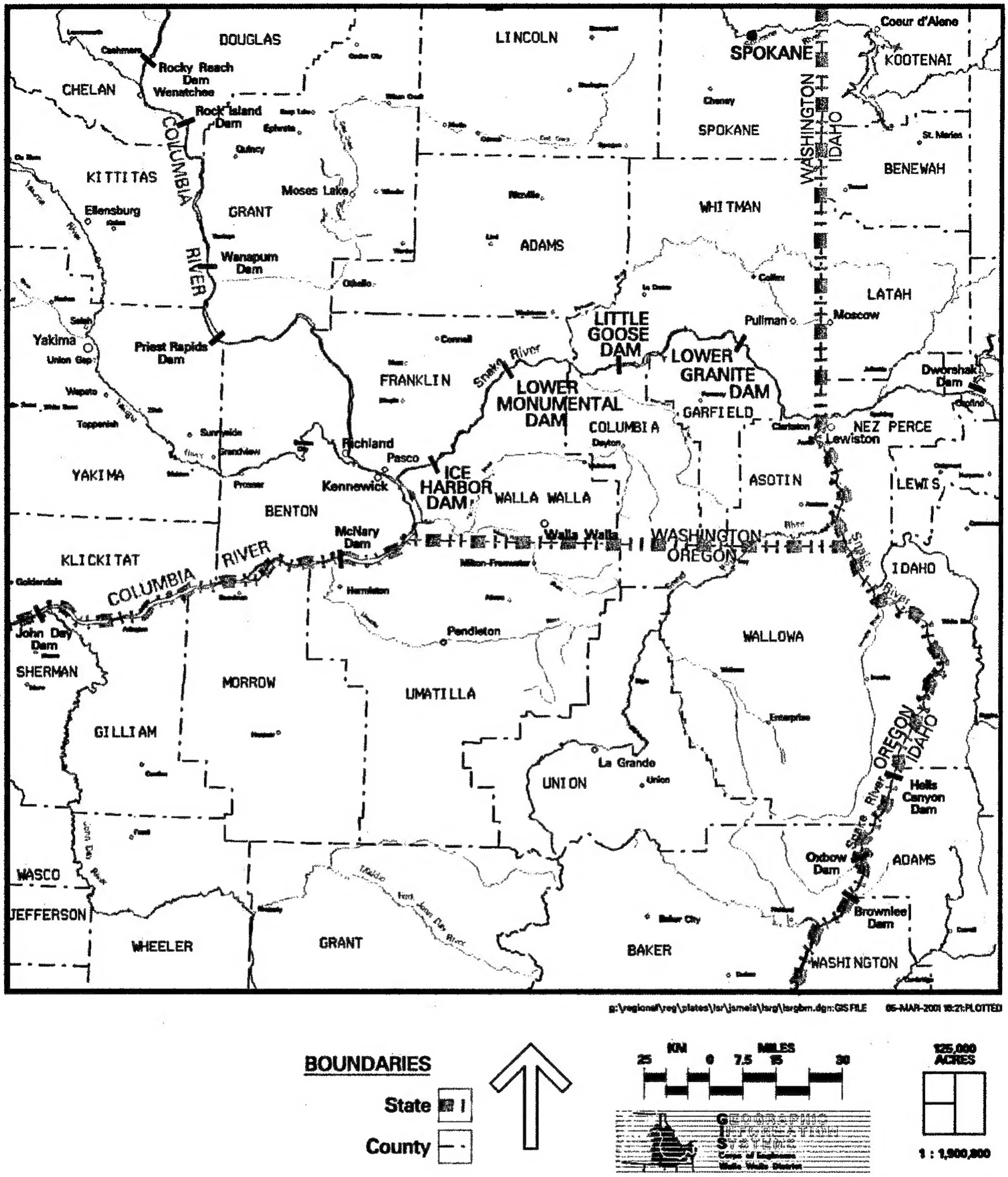
The **Maximum Transport of Juvenile Salmon Alternative** would include all of the existing or planned structural and operational configurations from the Existing Conditions Alternative. However, this alternative assumes that the juvenile fishway systems would be operated to maximize fish transport from Lower Granite, Little Goose, and Lower Monumental and that voluntary spill would not be used to bypass fish through the spillways (except at Ice Harbor). To accommodate this maximization of transport, some measures would be taken to upgrade and improve fish handling facilities.

The **Major System Improvements Alternative** would provide additional improvements to what is considered under the Existing Conditions Alternative. These improvements would be focused on using surface bypass facilities such as surface bypass collectors (SBCs) and removable spillway weirs (RSWs) in conjunction with extended submerged bar screens (ESBSs) and a behavioral guidance structure (BGS). The intent of these facilities would be to provide more effective diversion of juvenile fish away from the turbines. Under this alternative, an adaptive migration strategy would allow flexibility for either in-river migration or collection and transport of juvenile fish downstream in barges and trucks.

The **Dam Breaching Alternative** has been referred to as the "Drawdown Alternative" in many of the study groups since late 1996 and the resulting FR/EIS reports. These two terms essentially refer to the same set of actions. Because the term drawdown can refer to many types of drawdown, the term dam breaching was created to describe the action behind the alternative. The Dam Breaching Alternative would involve significant structural modifications at the four lower Snake River dams, allowing the reservoirs to be drained and resulting in a free-flowing yet controlled river. Dam breaching would involve removing the earthen embankment sections of the four dams and then developing a channel around the powerhouses, spillways, and navigation locks. With dam breaching, the navigation locks would no longer be operational and navigation for large commercial vessels would be eliminated. Some recreation facilities would close while others would be modified and new facilities could be built in the future. The operation and maintenance of fish hatcheries and HMUs would also change, although the extent of change would probably be small and is not known at this time.

Authority

The four Corps dams of the lower Snake River were constructed and are operated and maintained under laws that may be grouped into three categories: 1) laws initially authorizing construction of the project, 2) laws specific to the project passed subsequent to construction, and 3) laws that generally apply to all Corps reservoirs.



LOWER SNAKE RIVER
Juvenile Salmon Migration Feasibility Study

REGIONAL BASE MAP

US Army Corps
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Walla Walla District

Final

Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

Appendix Q

Tribal Consultation and Coordination

February 2002

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Walla Walla District

Final
Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

Appendix Q
Tribal Consultation and Coordination

Produced by

U.S. Army Corps of Engineers
Walla Walla District

February 2002

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FOREWORD

Appendix Q was prepared by U.S. Army Corps of Engineers (Corps), Walla Walla District staff. This appendix is one part of the overall effort of the Corps to prepare the Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (FR/EIS).

The Corps has reached out to regional stakeholders (Federal agencies, tribes, states, local governmental entities, organizations, and individuals) during the development of the FR/EIS and appendices. This effort resulted in many of these regional stakeholders providing input and comments, and even drafting work products or portions of these documents. This regional input provided the Corps with an insight and perspective not found in previous processes. A great deal of this information was subsequently included in the FR/EIS and appendices; therefore, not all of the opinions and/or findings herein may reflect the official policy or position of the Corps.

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CONTENTS

FIGURES

ACRONYMS AND ABBREVIATIONS

BIA	Bureau of Indian Affairs
BOT	Board of Trustees
Corps	U.S. Army Corps of Engineers
CTCIR	Confederated Tribes of the Colville Indian Reservation
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DEIS	Draft Environmental Impact Statement
DOD	Department of Defense
ESA	Endangered Species Act
FCRPS	Federal Columbia River Power System
Feasibility Study	Lower Snake River Juvenile Salmon Migration Feasibility Study
FEIS	Final Environmental Impact Statement
FR/EIS	Lower Snake River Juvenile Salmon Mitigation Feasibility Report/Environmental Impact Statement
NAGPRA	Native American Graves Protection and Repatriation Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPTEC	Nez Perce Tribe Executive Council

ENGLISH TO METRIC CONVERSION FACTORS

To Convert From	To	Multiply By
LENGTH CONVERSIONS:		
Inches	Millimeters	25.4
Feet	Meters	0.3048
Miles	Kilometers	1.6093
AREA CONVERSIONS:		
Acres	Hectares	0.4047
Acres	Square meters	4047
Square Miles	Square kilometers	2.590
VOLUME CONVERSIONS:		
Gallons	Cubic meters	0.003785
Cubic yards	Cubic meters	0.7646
Acre-feet	Hectare-meters	0.1234
Acre-feet	Cubic meters	1234
OTHER CONVERSIONS:		
Feet/mile	Meters/kilometer	0.1894
Tons	Kilograms	907.2
Tons/square mile	Kilograms/square kilometer	350.2703
Cubic feet/second	Cubic meters/sec	0.02832
Degrees Fahrenheit	Degrees Celsius	(Deg F –32) x (5/9)

Executive Summary

The United States has long recognized the dependent sovereign status of Indian tribes. Principles outlined in the United States Constitution and treaties, as well as those established by Federal laws, regulations, and executive orders, continue to guide the nation's policy toward Indian nations.

The U.S. Army Corps of Engineers (Corps) conducts its government-to-government relationships with Federally recognized Indian tribes as a part of its obligations, just as it does with states, counties, and local governments. The relationship the Federal government maintains with tribes is unique and necessarily involves consultation with tribal governments. The Corps is responsible for assessing the impacts of agency activities, considering tribal interests, and assuring that tribal interests are considered in conjunction with Federal activities and undertakings.

The Corps recognizes that tribal governments are sovereigns located within and dependent upon the United States. Yet tribes have rights to set their own priorities, to develop and manage tribal resources, and to be consulted in Federal decisions and activities having the potential to affect tribal rights. The Corps has a responsibility to help fulfill the United States government's responsibilities toward tribes when considering actions that may affect tribal rights, resources, and assets.

Several tribal chairpersons and tribal representatives have met with Corps commanders and Walla Walla District representatives regarding the Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (FR/EIS). The Corps has coordinated with other potentially affected tribes. This effort has involved programs for tribal representatives and staff to help ensure information is exchanged and a range of viewpoints held by tribes considered. Issues raised in these meetings have indicated concerns about agency actions and their effects on culturally significant species such as salmonids and Pacific lamprey fish, the effectiveness of proposed alternatives for fish passage through the hydropower facilities, effects on other natural resources and cultural resource sites, and how these influences would impact Indian communities.

This appendix along with numerous other appendices of the FR/EIS describe the Corps' work toward identifying, considering, and protecting tribal rights and integrating tribal interests and concerns into the planning process. The Corps is committed to carrying out Federal activities in a manner that is consistent with the United States' legal obligations toward tribes.

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1. Introduction

The Federal government has a unique relationship with American Indian peoples and Federally recognized tribal governments. Principles outlined in the United States Constitution and treaties, historic executive orders, and mandates established in Federal laws, regulations, and modern executive orders, continue to guide our national policy towards American Indian nations.

Prior to the formation of Federally recognized tribes, the indigenous peoples of the lower Snake River region lived in villages comprised of several extended families. Groups of villages known as bands were bound together culturally, and collectively shared a homeland. The names of bands were typically taken from those of major villages. Through formal treaties and executive orders initiated by the United States government, groups of native bands were given Federal recognition as American Indian tribes. Although not always accurately represented in the treaties of the mid-1800s, the homelands of native peoples were thus ceded to the United States by tribes through treaties ratified by Congress. As domestic dependent nations, Indian tribes exercise inherent sovereign powers over their members and territory. American Indian tribes are defined as "any Indian band, nation, village or community" the Secretary of the Interior acknowledges to exist as an Indian tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a. Thus, the word tribe denotes Federal recognition of an American Indian government.

The modern tribes with cultural heritage pertaining to the lower Snake River are comprised of numerous communities associated with the Umatilla, Yakama, Nez Perce, and Colville reservations, and families associated with the Wanapum community at Priest Rapids, Washington. Tribal members are both Americans and tribal citizens who may receive representation from Federal, state, county, and local governments. The unique manner in which tribal governments represent their members is perhaps the most sensitive to their immediate economic and cultural needs and values. The potential effects of the Lower Snake River Juvenile Salmon Migration Feasibility Study (Feasibility Study) and EIS alternatives on tribes have been characterized by both tribal representatives and in a study of five affected tribes (Meyer Resources, 1999) in terms of effects on natural resources, habitats, and places that are culturally significant to tribes and their communities. The effects may directly relate to tribal economies and cultural practices and indirectly to people's health, social well-being, quality of life, and values for the natural and cultural environment associated with the lower Snake River.

Affected tribes and American Indian communities maintain cultural values in both natural and cultural resources managed by the Corps in the lower Snake River. Numerous aquatic, plant, and wildlife species retain cultural significance to tribes, e.g., salmonids, Pacific lamprey, sturgeon, whitefish, sculpin, deer, grouse, eagles, coyotes, bear, wolves, biscuitroot, Indian carrots, chokecherries, and tules. Values for the water, land, life forms, and places continue to be the source of Indian community concerns, as well as tribal governments' desires to protect their legal rights. Such values are lodged in both traditional life ways and modern socio-economic needs, which influence and impact tribes.

Changes to tribes' cultural identities and limitations imposed on traditional practices are ongoing. For example, the fisheries on and adjoining the lower Snake River system have been significantly altered over the past one and a half centuries in terms of access and habitat quality. Tribes that

desire to take treaty fish such as Pacific lamprey (largely a ceremonial and subsistence activity) find their fishermen displaced from local fishing stations. Tribes such as the Yakama, Nez Perce, and Umatilla currently catch lamprey from tributaries of the lower Columbia River.

Federally recognized tribes have the right to set their own priorities and develop and manage tribal resources within the Federal government framework. Efforts have been made to assess the impact of Federal agency activities on tribes and to ensure that tribal interests and rights are considered before Federal actions are undertaken (Meyer Resources, 1999). Tribal interests and rights are viewed by tribes and traditional communities with the spatial context of tribal ceded lands, traditional native homelands, and places traditionally used by native peoples. Places where tribes have rights to harvest resources may include fishing grounds and stations, root and berry fields, and hunting grounds. Of particular concern to tribes are the potential impacts from water resource management on anadromous fish runs and associated aquatic habitats, and tribal rights to fish for ceremonial, subsistence, and commercial needs.

In assessing effects of the Feasibility Study's proposed courses of action on tribes, the following factors may be considered: 1) economies of counties that encompass affected tribes and bands; 2) water quality and aquatic habitats; 3) accessibility to culturally and religiously significant places and resources; 4) viability and harvestability of culturally significant species; and 5) quality of habitat places that would impact treaty rights to hunt, fish, gather, and graze livestock. Short- and long-term effects on these factors are expected to differ.

2. American Indian Issues and Concerns

Some affected Indian tribes have significant interest in the development of the Feasibility Study and potential effects of its EIS. These tribes assert a general concern for the ecosystem of the area and cultural places, e.g., burial sites and harvest sites. Tribal concerns focus on the potential effects of the Feasibility Study on treaty rights—especially the right to fish for resources in the lower Snake River area. Most notably, tribes have emphasized the recovery of anadromous fish runs and interest in the potential to regain access to usual and accustomed harvest places. Specific interest in the location and potential use of tribal allotments and the precise process of agency-tribe consultation, although important, was secondary. Tribes expressed their understanding of cultural resources as inclusive of natural resources as well as historical and archaeological components. Tribes, therefore, would like their interests and rights considered within the context of certain tribal cultural values and perspectives not universally represented in Federal decision-making.

The Federal government's trust responsibilities to tribes are meant to occur through on-going meaningful Federal agency consultation with tribal governments. The context for tribal interest must be examined both from the perspective of Federal legal responsibilities as well as those points raised by tribal government representatives. Protection of treaty rights and resources and cultural resources are of interest to both tribes and the Corps.

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3. Government-to-Government Relations

National policy statements originating from the executive branch of the Federal government provide direction to Federal agencies on how to formulate relations with American Indian tribes and people and deal with common issues. The following are those most often referred to by Federal and tribal representatives:

1983—Presidential Statement on American Indian Policy (19 Weekly Comp. Doc. 98-102). President Reagan's statement dated January 24, 1983, provided direction on treatment of American Indian tribes and their interests.

1984—Department of Defense Directive No. 4710.1- June 21.

1993—Executive Order 12866, Regulatory Planning and Review. The Order enhanced planning and coordination concerning new and existing regulations. It made the regulatory process more accessible and open to the public. Agencies were directed to seek views of tribal officials before imposing regulatory requirements that might affect them.

1994—Executive Order 12898 on Environmental Justice.

1994—White House Memorandum for the Heads of Executive Departments and Agencies. This emphasized the importance of government-to-government relations with tribal governments and the need to consult with tribes prior to taking actions that may affect tribal interests, rights, or trust resources.

1994—Government-to-Government Relations with Native American Tribal Governments, Memorandum of 22 April 1994.

1995—Government-to-Government Relations. The United States Justice Department, Attorney General, issued and signed a policy statement on government-to-government relations on June 1, 1995. It includes references to tribes' sovereignty status and the Federal government's trust responsibility to tribal governments.

1998—Executive Order 13084, Consultation and Coordination with Indian Tribal Governments, 14 May 1998.

Policy Guidance Letter No. 57, Indian Sovereignty and Government Relations with Indian Tribes. Implements Executive Order 13084.

1998—DOD American Indian and Alaskan Native Policy, 20 October 1998.

1999—Project Operations Native American Policy, 12 July 1999.

2000—Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, 6 November 2000.

As noted in Executive Order 13084, the Federal government continues to work with tribes on issues concerning tribal self-government, trust resources, tribal treaty, and other rights as one government to another government. The Order directs agencies to consider affected Federally recognized tribes through the following policy principles:

1. The United States has a unique legal relationship with Indian Tribal governments as set forth in the Constitution, treaties, statutes, executive orders, and court decisions.
2. Tribes, as dependent nations, have inherent sovereign powers over their members and territories with rights to self-government. The United States works with tribes as one government to another government addressing issues concerning tribal self-government, trust resources, and tribes' treaty and other rights.
3. Agencies will provide regular, meaningful, and collaborative opportunities to address the development of regulatory practices that may have significant or unique effects on tribal communities.
4. Cooperation in developing regulations on issues relating to tribal self-government, trust resources, or treaty and other rights should use, where appropriate, consensus building methods such as rule-making.

The historic development of Federal relations with tribes is based also on many important legal concepts and congressional actions that now form the basis of modern government-to-government relations.

4. Consultation and Coordination Requirements

The relationships between the Federal government and different tribes and traditional Indian communities have evolved over our nation's history. Tribes retain certain inherent powers of self-government and thereby may seek to participate in Federal decisions or activities that have the potential to affect their rights and interests. Indian treaties, Federal statutes, executive orders, national policies, and court cases have collectively and over time caused changes in how these special Federal relationships are exercised. Currently, affected tribes and traditional Indian communities are involved in both local and regional Federal decisions/activities that have the potential to affect their rights and interests. Federal policies and statutes have directed Federal agencies to consult and coordinate with American Indian tribes and traditional communities about their actions. In facilitating this process, the Corps routinely seeks to provide "meaningful and timely opportunities" for tribes to comment on agency policies that may have significant or unique effects on tribal interests (DOD American Indian and Alaskan Native Policy, 20 October 1998).

4.1 Laws and Statutes Relating to Tribal Interests

There is an extensive list of Federal laws, executive orders, policy directives, and Federal regulations that place legal responsibilities on executive branch agencies. Collectively, these legally binding authorities, which continue to form the basis of how consultation is conducted, have had a profound impact on Federal-tribal relations. An example is the *National Environmental Policy Act of 1969 (NEPA; 83 Stat. 852; 42 U.S.C. 4321 et seq./P.L. 91-190),* which established a framework of public and tribal involvement in land management planning and actions. NEPA also provides for consideration of historic, cultural, and natural aspects of our environment. The *National Historic Preservation Act of 1966 (P.L. 89-665, as amended by P.L. 91-423, P.L. 94-422, P.L. 94-458, and P.L. 96-515),* known as NHPA, was amended in 1992. On July 1, 1999, new NHPA implementing regulations were adopted, which implement the Act and also clarify it. The NHPA explicitly directs Federal agencies to involve tribes along with other consulting parties in the process of identifying historic properties. Specifically, places of cultural and religious significance to tribes are to be considered by Federal agencies in policy and project planning. Cultural properties significant to traditional communities have become a type of historic property that Federal agencies must identify and manage.

"Consultation" is achieved through an effective communication process in which government officials engage in regular and meaningful discussions with representatives of Indian tribal governments (Executive Order 13084). The Walla Walla District Corps of Engineers is increasingly engaging and involving tribes in collaborative processes designed to facilitate the exchange of information and to effectively address effects of Federal actions and policies on tribal interests and rights.

4.2 Corps Policy Guidance and American Indian Tribes

In February 1998, Lt. General Joe N. Ballard, Chief of Engineering, published a Memorandum for Commanders, Major Subordinate Commands, and District Commands: Policy Guidance

Letter No. 57, Indian Sovereignty and Government-to-Government Relations with Indian Tribes. It is reproduced here:

1. Our Nation has long recognized the sovereign status of Indian tribes. The United States Constitution specifically addresses Indian sovereignty by classing Indian treaties among the "supreme law of the land," and established Indian affairs as a unique focus of Federal concern. Principles outlined in the treaties, as well as those established by Federal laws, regulations, and Executive Orders, continue to guide our national policy towards Indian Nations.

2. On 29 April 1994, President Clinton reaffirmed the United States' "unique legal relationship with Native American tribal governments." In recognition of the special considerations due to tribal interests, the President directed Federal agencies to operate within a government-to-government relationship with Federally recognized Indian tribes; consult, to the greatest extent practicable and permitted by law, with Indian tribal governments; assess the impact of agency activities on tribal trust resources and assure that tribal interests are considered before the activities are undertaken; and remove procedural impediments to working directly with tribal governments on activities that effect [sic] trust property or governmental rights of the tribes....

3. I want to ensure that all Corps Commands adhere to principles of respect for Indian tribal governments and honor our Nation's trust responsibility. To this end I have enclosed U.S. Army Corps of Engineers Tribal Policy Principles for use as interim guidance until more detailed statements are developed. These Principles have been developed with the Office of the Assistant Secretary of the Army (Civil Works) and are consistent with the President's goals and objectives.

Tribal Sovereignty—The Corps recognizes that Tribal governments are sovereign entities, with rights to set their own priorities, develop and manage Tribal and trust resources, and be involved in Federal decisions or activities which have the potential to affect these rights.

Trust Responsibility—The Corps will work to meet trust obligations, protect trust resources, and obtain Tribal views of trust and treaty responsibilities or actions related to the Corps, in accordance with provisions of treaties, laws and Executive Orders as well as principles lodged in the Constitution of the United States.

Government-to-Government Relations—The Corps will ensure that Tribal Chairs/Leaders meet with Corps Commanders/Leaders and recognize that, as governments, tribes have the right to be treated with appropriate respect and dignity, in accordance with principles of self-determination.

Pre-Decisional and Honest Consultation—The Corps will reach out, through designated points of contact, to involve tribes in collaborative processes designed to ensure information exchange, consideration of disparate viewpoints before and during decision making, and utilize fair and impartial dispute resolution mechanisms.

Self Reliance, Capacity Building and Growth—The Corps will search for ways to involve tribes in programs, projects and other activities that build economic capacity and foster abilities to manage Tribal resources while preserving cultural identities.

Natural and Cultural Resources—The Corps will act to fulfill obligations to preserve and protect trust resources, comply with the Native American Graves Protection and Repatriation Act, and ensure reasonable access to sacred sites in accordance with published and easily accessible guidance.

In August 2001, Clifton P. Jackson, Jr., Executive Assistant for the Commander, published CENWD-NA Regulation No. 5-1-1, Native American Policy for the Northwestern Division, covering the policy, responsibilities, and implementation of the Corps' Tribal Policy Principles. This regulation applies to all Northwestern Division commands having responsibility for Civil Works (CW), military, and Hazardous, Toxic and Radioactive Waste (HTRW) functions. The policy and responsibilities associated with this regulation are reproduced here:

> *Policy*—It is the policy of the Northwestern Division to apply the Corps' Tribal Policy Principles in all division activities that may impact any federally recognized Indian Tribe. In those activities where consultation is warranted, it is the policy of the Northwestern Division to consult on a government-to-government level consistent with guidance found in this regulation.
>
> *Responsibilities*—
>
> Division Commander responsibilities:
>
> 1. The Division Commander is responsible for integrating the Corps' Tribal Policy Principles into all division activities that may impact any federally recognized Indian Tribe.
> 2. The Division Commander will provide regional interface with Tribal governments for activities or issues involving multiple districts and refer appropriate actions to the affected district(s).
> 3. The Division Commander will develop a Tribal account management plan to guide business development and outreach opportunities that promote Corps capabilities while fostering Tribal self reliance, capacity building, and growth.
> 4. The Division Commander will formally designate and train a Native American Coordinator(s) with primary or collateral duties to provide quality assurance of district Native American programs and activities.
>
> District Commander responsibilities:
>
> 1. The District Commander is responsible for integrating the Corps' Tribal Policy Principles into all district activities that may impact any federally recognized Indian Tribe.
>   - ***Tribal Sovereignty***—The district will affirm the sovereign status of Tribal governments and work to develop and enhance a relationship which acknowledges the right of federally recognized Tribes to set their own priorities and develop and manage tribal and trust resources.
>   - ***Trust Responsibility***—The district will work to meet Tribal needs related to district activities and work to protect trust resources.
>   - ***Government-to-Government Relations***—The District Commanders and their designated staff representatives will meet with Tribal governments at the government-to-government level and observe tribal protocols and standards of dignity.
>   - ***Pre-decisional and Honest Consultation***—The District Commanders and designated staff will consult with Tribal governments following the general concepts of the Guidelines for Army Consultation with Native Americans and DOD American Indian and Alaska Native Policy.

- *Self-reliance, Capacity Building, and Growth*—The district will actively promote Corps' capabilities, business development, and outreach opportunities with Tribes. The district will involve Tribes in district programs that foster self-reliance, build economic capacity and growth such as training, cultural and natural resources, recreation, watershed planning, environmental restoration, emergency management, and contracting opportunities.

- *Natural and Cultural Resources*—Consistent with procedures set forth in applicable federal laws, regulations, and policies, the district will proactively work to preserve and protect natural and cultural trust resources; establish Native American Graves Protection and Repatriation Act (NAGPRA) protocols and procedures; and allow reasonable access to sacred sites.

2. The District Commander will formally designate and train a Native American Coordinator with primary or collateral duties to assist the Commander and other functional staff elements in ensuring that Tribal Policy Principles and consultation are integrated into all district activities. The District Commander shall ensure Native American issues, activities, and contacts with Tribal governments are coordinated with the Native American Coordinator.

4.3 Off-Reservation Rights

Of special significance to the Feasibility Study are those tribes with treaty provisions dealing with off-reservation rights to hunt, fish, gather roots and berries, and graze livestock:

1855—June 9 Treaty with Yakama (12 Stat. 951 et seq). The treaty applies to 14 bands and tribes of the Yakama Indian Nation. Treaty Article 3 in part states, "The exclusive right of taking fish in all the streams, where running through or bordering said reservation, is further secured to said confederated tribes and bands of Indians, as also the right of taking fish at all usual and accustomed places, in common with the citizens of the territory, and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land" (see Annex A).

1855—June 9 Treaty with Walla Walla, Cayuse, and Umatilla (12 Stat. 945 et seq). Treaty Article 1 states in part, "That the exclusive right of taking fish in the streams running through and bordering said reservation is hereby secured to said Indians, and at all other usual and accustomed stations in common with citizens of the United States, and of erecting suitable buildings for curing the same; the privilege of hunting, gathering roots and berries and pasturing their stock on unclaimed lands in common with citizens, is also secured to them" (see Annex A).

1855— June 11 Treaty with Nez Perces (12 Stat. 957). Treaty Article 3 in part states, "The exclusive right of taking fish in all the streams where running through or bordering said reservation is further secured to said Indians; as also the right of taking fish at all usual and accustomed places in common with citizens of the territory; and of erecting temporary buildings for curing, together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land" (see Annex A).

1863—*June 9 Treaty with Nez Perce Tribe (14 Stat. 647).* Treaty Article 8 states in part, "The United States also agree [sic] to reserve all springs or fountains not adjacent to, or directly connected with, the streams or rivers within the lands hereby relinquished, and to keep back from settlement or entry so much of the surrounding land as may be necessary to prevent the said

springs or fountains being enclosed; and further, to preserve a perpetual right of way to and from the same, as watering places, for the use in common of both whites and Indians" (see Annex A).

1868—August 13 Treaty with the Nez Perces (15 Stat. 693). This treaty in part amended the Nez Perces treaty of 1863 and pertains to those lands set apart for the exclusive use and benefit of the Nez Perces Tribe, which were ceded to the U.S. Government, thereby diminishing the size of their reservation. Treaty Article 1 reads in part, "…and it is further agreed that those residing outside of the boundaries of the reservation and who may continue to so reside shall be protected by the military authorities in their rights upon the allotments occupied by them, and also in the privilege of grazing their animals upon surrounding unoccupied lands" (see Annex A).

1868—*July 3 Fort Bridger Treaty (15 Stat. 673).* Treaty Article 4 reads in part, "The Indians herein named…shall have the right to hunt on the unoccupied lands of the United States so long as the game may be found thereon, and as long as the peace subsists among the whites and the Indians on the borders of the hunting districts" (see Annex A).

The language in each of these treaties identified certain pre-existing rights that were retained by the tribal governments through which tribal citizens could exercise rights, e.g., the right to fish at usual and accustomed places and hunt, gather roots and berries, and pasture livestock on open and unclaimed land. In turn, tribal lands, including those along the lower Snake River along with the rest of their homelands, were to be ceded to the United States Government with the exception of their Indian Reservations.

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5. Affected Tribes and Bands

There are 14 American Indian tribes and bands whose interests and/or rights may be affected by the proposed Federal actions in the Lower Snake River Feasibility Study and its EIS. The Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes and Bands of the Yakama Indian Nation of the Yakama Reservation, and Nez Perce Tribe either have treaty rights, ceded lands, or other direct interests in the Feasibility Study area that may be affected by FR/EIS alternatives. The Confederated Tribes of the Colville Indian Reservation and the Wanapum band have interests and some rights within the lower Snake River area. The District also identified nine other tribes that may be affected directly or indirectly by proposed Federal actions:

- Burns Paiute Tribe of the Burns Paiute Indian Colony
- Coeur d'Alene Tribe
- Confederated Tribes of the Warm Springs Reservation of Oregon
- Kalispel Indian Community of the Kalispel Reservation
- Kootenai Tribe of Idaho
- Northwestern Band of the Shoshoni Nation
- Shoshone-Bannock Tribes of the Fort Hall Reservation
- Shoshone-Paiute Tribes of the Duck Valley Reservation
- The Spokane Tribe of the Spokane Reservation.

A Tribal Circumstances Report (Meyer Resources, 1999) was contracted by the Corps, which focused on five study tribes, and developed specific information concerning the alternatives and their potential to affect the Native American rights and interests. The study tribes were selected from those affected tribes with ceded lands and treaty rights near the lower Snake River: Confederated Tribes of the Umatilla Reservation, Confederated Tribes and Bands of the Yakama Indian Nation of the Yakama Reservation, and Nez Perce Tribe. The Confederated Tribes of the Warm Springs Reservation of Oregon and the Shoshone-Bannock Tribes of the Fort Hall Reservation were also selected, as they have similar rights and interests in an area that is outside the Feasibility Study and that could be affected by management decisions at the lower Snake River hydropower facilities. The Confederated Tribes of the Warm Springs Reservation was included to consider potential effects on a tribe with interests and rights outside of the Feasibility Study under EIS alternatives, e.g., effects on treaty fishing rights. The study of these five tribes was intended to provide a framework to assess potential effects on their rights and interests, and consider those effects in conjunction with the other 11 identified affected tribes.

The names of tribes and bands discussed in this section are taken from ratified treaties and signed executive order documents, which formed the basis for a tribe's formal Federal recognition. In a few instances, additional names preferred by a tribe to identify a band or tribal subdivision are also noted. Many of the names in this section are anglicized versions of native terms, historical creations, or a historic version of another band's name for the group—usually a neighboring band/tribe. There are other native names and member bands that a tribe may recognize.

5.1 Burns Paiute Tribe of the Burns Paiute Indian Colony

Members of the Walpapi Band of the Northern Paiute signed a Treaty with the "Snake" band in 1865. The tribe signed a treaty with the U.S. Government in December 1868; Congress failed to ratify it. The Executive Order of March 1872 established the Malheur Indian Reservation and recognized the Burns Paiute Indians. In 1883, however, another executive order dissolved the reservation and the tribe lost Federal recognition. The 1.8-million-acre Malheur Indian Reservation was terminated and the land was made public domain. The 1887 Indian Allotment Act allowed for 160 acres to be claimed by each tribal head of household. The Burns Paiute Tribe is located in eastern Harney County, Oregon. Tribal headquarters are in Burns, Oregon. In 1972 the United States transferred title to 762 acres to the Burns Paiute and established the Burns Paiute Reservation through Public Law 92-488.

The current reservation consists of 771 acres, and another 11,786 acres of allotments is owned by tribal members. An additional 360 acres is held in trust and administered for the Tribe by the Bureau of Indian Affairs. The tribe is self-governing. A Tribal Council of seven elected members was established by the tribe in 1988.

The peoples represented by the tribe are of the Great Basin Cultural Region consisting of the northern division of the Paiute peoples. The original homeland of the Northern Paiute peoples included southeast Oregon, most of northwestern Nevada, and a portion of southwest Idaho. Northern Paiute associated with the Burns Indian Reservation include the remnants of the Wadaika band (Wada Eaters who historically lived around Malheur and Harney lakes); the Hunipui (Juniper-Deer Eaters of the Crooked River area); the Walpapi (Elk Eaters of the upper John Day River area); the Tagu (Salmon Eaters of the Owyhee River area); the Kidu (Groundhog Eaters of the Fort Bidwell area); and the Koa'agai. Northern Paiute and English are spoken by the tribe. Major religious affiliations include traditional Indian religions and denominations of Christianity.

5.2 Coeur d'Alene Tribe

In 1867 an entity called the Coeur d'Alene Reservation was created for the Coeur d'Alene, Kalispel, Spokane, Sanpoil, and Colville "bands." The Coeur d'Alene never moved to that reservation. In 1873, a 592,000-acre reservation was created by Executive Order for the Coeur d'Alene Tribe. In following years, the reservation area was reduced, lands ceded, and portions removed from the reservation. Today's reservation consists of 345,000 acres in northern Idaho.

Tribal government is under a constitution originally approved September 2, 1949. The Tribal Council is the legislative body. Tribal headquarters are in Plummer, Idaho.

Peoples represented by the tribe are of the Plateau Cultural Region and are of the Coeur d'Alene, Spokane, and St. Joe River Tribes and Bands. In 1842 a Catholic mission for the tribe was established near St. Maries by Father Pierre DeSmet. Today religious affiliations include traditional Indian religions and denominations of Christianity. Interior Salish and English are spoken by the tribal peoples.

5.3 Confederated Tribes of the Colville Indian Reservation

The basis for formal Federal recognition of the Confederated Tribes of the Colville Indian Reservation (CTCIR) and the CTCIR's inherent sovereignty was established through the "Nez

Perce" and "Yakama" Treaties of June 9, 1855. Executive Order of April 9, 1872, which was superseded by Executive orders of March 6, 1879, February 23, 1883, March 6, 1880, and May 1, 1886; Agreements of May 9, 1891, July 1, 1892, December 1, 1905, and March 22, 1906; and the Act of June 20, 1940, all helped refine the Colville Tribe's relationship with the United States government.

The Colville Reservation was established in April 9, 1872, in north-central Washington. Modifications to the reservation size, status, and location in later years resulted in the present 1.4-million-acre reservation in north-central Washington. The basis of the tribe's off-reservation rights and interests is derived from the Yakama and Nez Perce treaties of 1855, Article 3, and a 1891 Agreement, Article 6. It is through the Yakama Treaty that members of the Palous band moved onto the Colville Reservation in the late 19th century. The Colville tribe asserts rights and interests in ceded lands of the Palous people along the lower Snake River.

The Colville Tribe did not adopt the Indian Reorganization Act of 1934, but did establish a constitutional form of government with a Business Council in 1938. The tribe's Business Council membership is chosen from four reservation districts comprised of two groups of seven council members who are elected to 4-year terms in staggered biennial elections. The chair and vice-chair Business Council positions are filled through elections held by its Executive Committee, while all other positions are elected by the entire Business Council membership. The General Council meets biannually to provide direction to the Business Council. Since 1995, the Colville Tribes have operated under a tribal self-determination agreement with the Bureau of Indian Affairs (BIA) that has integrated BIA staff positions with the tribe's. Colville Tribal Headquarters are located in Nespelem, Washington.

The CTCIR represent peoples of the Plateau Culture Area including the Methow, Sanpoil, Lakes, Colville (Sweelpoo), Kalispel, Spokane, Entait, Nespelem, Chelan, Columbia (Senkaiuse), Chief Joseph Band of the Nez Perce (Nimipu), Wenatchee (Wenatchapum), Southern Okanogan (Sinkaietk), Palous, and Lakes (Senijextee). Interior Salish, Sahaptin, and English are spoken by the tribal population. Religious affiliations include traditional Indian religions and denominations of Christianity.

5.4 Confederated Tribes of the Umatilla Indian Reservation

The 1855 "Treaty with the Walla Walla, Cayuse, and Umatilla Tribes," subsequent treaties, and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Constitution form the basis for formal recognition of the tribes' inherent sovereignty. The tribal government's off-reservation treaty rights are recognized in Article 1 of the treaty. Congress ratified this treaty in 1859 and a reservation was established encompassing 254,699 acres in what has become northeastern Oregon. The size of the reservation was reduced through subsequent congressional acts and today consists of 89,350 acres of trust and allotted lands. The tribes rejected the Indian Reorganization Act in 1935 by tribal referendum. A Constitution and By-laws were, however, adopted in 1949. The tribal governing body consists of a General Council and a Board of Trustees (BOT). The BOT is a nine-member council that sets tribal policy and makes final tribal decisions. The BOT members are elected together in a single election for two-year terms. All BOT members, except the chairperson, participate in tribal commissions and committees and thereby oversee tribal business. Tribal headquarters are in Mission, Oregon.

The bands represented by the CTUIR were affiliated with the southern Plateau Culture Area. English, Sahaptin dialects, and the Nez Perce language are spoken by tribal citizens. Major religious affiliations include traditional Indian religions and Christian denominations.

5.5 Confederated Tribes of the Warm Springs Reservation of Oregon

In 1855, the sovereignty of the Confederated Tribes of the Warm Springs Reservation was recognized in the "Treaty with the Tribes of Middle Oregon." Today's reservation, in central Oregon, consists of 640,000 acres, 480,196 acres of which is tribal-owned.

The tribes adopted the Indian Reorganization act in 1935 and adopted a constitution and by-laws in 1938. The tribes have an elected Tribal Council and various tribal committees and boards. The tribes are self-governing. Tribal headquarters are in Warm Springs, Oregon.

Peoples represented on the Reservation are of Plateau and Great Basin cultural regions and are from the Wasco Bands—Dalles, Ki-gal-twal-la, and Dog River; Warm Springs — Taih or Upper Deshutes, Wyam (Lower Deshutes), Tenino, Dock-Spus (John Day River); and Northern Paiutes (removed to Warm Springs Reservation in the 1880s) groups. Languages spoken by tribal members include English, Chinookan, Sahaptin, and Shoshonean (Northern Paiute). Major religious affiliations include traditional Indian religions, traditional belief systems, and Christian denominations.

5.6 Confederated Tribes and Bands of the Yakama Indian Nation of the Yakama Reservation

In 1855, the "Yakima Treaty" established the Yakama Nation and a reservation in what is now south-central Washington. Pre-treaty lands included about a quarter of the modern State of Washington. Other binding treaty documents include the Agreement of January 13, 1885; Executive Order of November 21, 1892; and Executive Order 11670. A number of land ownership changes have resulted in the current 1.2-million-acre reservation. As a point of interest, the spelling of Yakama was changed from Yak[i]ma back to the original spelling in the Treaty of 1855 by a vote of the Tribal Council on January 24, 1994. In 1999, the tribal government has also indicated a preference to be known as the Yakama Nation.

The Tribal Council comprised of 14 members is the governing body. The General Council elects Tribal Council members in elections held every 2 years wherein half of the Tribal Council is elected to 4-year terms. The tribe's democratic government is regulated by General Council and Tribal Council resolutions. The tribe rejected the Indian Reorganization Act in 1935. The tribe has a self-determination form of government and operates under traditional laws, ordinances, and resolutions as opposed to having a constitution. The Tribal Council oversees tribal business through eight standing committees and seven special committees. The General Council meets annually for an extended period of time to provide direction to the Tribal Council. The Tribal Headquarters are in Toppenish, Washington.

The 14 bands represented on the Reservation include the Klickitat, Klinquit, Li-ay-was, Kow-was-say-ee, Oche-chotes, Palous, Shyiks, Pisquose, Se-ap-cat, Skinpah, Wishram, Wenatshpam, Yakama, and Kah-milt-pah. These are all peoples of the southern Plateau Cultural Area.

Religious affiliations include traditional Indian religions and belief systems, and denominations of Christianity. Languages spoken on the reservation include English, numerous dialects of Sahaptin, Chinookan, and Salish.

5.7 Kalispel Indian Community of the Kalispel Reservation

This tribe's inherent sovereignty was recognized through an agreement with about half of the Kalispel Tribe in an Executive Order dated April 21, 1887. In 1904, another executive order established a reservation for the tribe. However, the U.S. Government wanted to move the Kalispel to the Flathead Reservation. In the end, a second 4,630-acre reservation was established in northeastern Washington on March 23, 1914. Today the reservation is about 4,550 acres. A Tribal Constitution and Charter was originally adopted on March 24, 1938. In addition to the constitution, tribal council resolutions create tribal law. The tribal headquarters are in Usk, Washington.

Peoples from tribes and bands of the "People of the Pend Oreille" are represented on the reservation. These peoples are of the Plateau Cultural Region. Major religious affiliations include Christian denominations, primarily Catholic. English and Interior Salish dialects are spoken.

5.8 Kootenai Tribe of Idaho

The Treaty with the Flathead, Kootenai, and Upper Pend d'Oreilles of July 16, 1855 established the tribe's sovereignty of the Kootenai Tribe of Idaho. Some Kootenai living in the vicinity of the Canadian border did not move to the Flathead Reservation in Montana when it was established. A group of Kootenai families living near Bonners Ferry were recognized by the U.S. Government in 1894. By 1972 a reservation existed of approximately 2,683 acres. Today's reservation is approximately 1,300 acres. The tribe adopted a constitution in 1947. A revision of the constitution has been proposed. In addition to the constitution, the tribe is regulated by a code of conduct. Tribal Headquarters is in Bonners Ferry, Idaho.

The Kootenai peoples were composed of two groups, Upper and Lower. Two of the three bands of Lower Kootenai now reside in Canada. Major religions followed by the tribe include denominations of Christianity and traditional belief systems. Languages spoken are English and Kitunahan dialects.

5.9 Nez Perce Tribe

The "Nez Perce Treaty" of June 11, 1855, and subsequent treaties, acts, agreements, and proclamations established the legal status of the Nez Perce Tribe. A reservation of 7.7 million acres was established in 1855. In 1863 the reservation was re-established with 780,000 acres. The present reservation is 750,000 acres between the Clearwater and Snake rivers in Idaho. The tribe rejected the Indian Reorganization Act in 1935 by tribal referendum. A constitution and by-laws were originally adopted in 1927. The tribe is self-governing under a constitution, which was adopted in 1958 and revised in 1961. The Nez Perce Tribe Executive Council (NPTEC) is the tribe's primary governing authority and it meets formally twice a month. The tribe's governing body (composed of tribal membership) is the general council and it meets twice a year. The general council elects three of the nine NPTEC members every year in September. There is no

provision under the Nez Perce Council to hold special General Council meetings. Tribal headquarters are in Lapwai, Idaho.

People represented by the tribal government are of the tribe and bands of the Nez Perce People (Nee-Mee-Poo) and are associated with the southern Plateau Culture Area. Major religious affiliations include Christian denominations and traditional Indian religions and belief systems. English and Sahaptin Nez Perce language dialects are spoken. There is a Nez Perce newspaper published by the tribe.

5.10 Northwestern Band of the Shoshoni Nation

Legal status of the Northwestern Band of the Shoshone Nation is based on the "Treaty of Box Elder" of June 30, 1863, and subsequent Acts and Agreements. By 1900 many of the Northwestern Band resided on the Fort Hall Reservation. Others now reside in Utah and Idaho communities. In 1989 the tribe acquired 187 acres of land that constitutes the present reservation in north-central Utah. Other, nearby land parcels are held in trust by the BIA. A constitution was approved on August 24, 1987. The tribe did not accept the Indian Reorganization Act of 1935. The tribe is self-governing with a General Council of all adult enrolled tribal members and an elected Tribal Council. Tribal headquarters are in Brigham, Utah.

The Northwestern Band of Shoshoni includes the Weber Utes, Northwestern Shoshoni, and other Shoshoni people from the Lemhi area of southeastern Idaho. Traditional religions and denominations of Christianity are the major religious affiliations. Shoshone and English are spoken.

5.11 Shoshone-Bannock Tribes of the Fort Hall Reservation

The Treaty with the Eastern Shoshoni Tribe of 1863 and subsequent treaties, acts, and agreements form the basis for the sovereignty of the Shoshone-Bannock tribes. The Treaty reservation was originally established at 1.8 million acres. The present reservation comprises 544,000 acres in southeast Idaho. The Tribal governments for the Shoshone and Bannock peoples operate under a constitution and by-laws adopted in 1977, the Land Use Ordinance, the Big Game Code, the Law and Order Code, inherent sovereignty, customs, and traditions. The legislative body is the elected Fort Hall Business Council.

The Shoshone-Bannock Tribes compose one Federally recognized tribe that includes two distinct groups: the Northern or Snake River Shoshone, and the Bannocks. The four Northern Shoshone Band divisions include the Western Shoshone (Warraeekas), including the Boise and Bruneas; the Mountain Lemhi Shoshone, including the Tukuerukas (Sheepeaters) and the Agaidikas (Salmon Eaters); the Northwestern Shoshone, including the Bear Lakes, Cache Valley, Bannock Creek, and Weber Ute; and the Pohogue (Fort Hall) Shoshone. Major religious affiliations include Christian denominations, the Native American Church, and traditional beliefs. Languages spoken include English, Shoshone, Bannock, and other dialects.

5.12 Shoshone-Paiute Tribes of Duck Valley Reservation

The Executive Order of April 16, 1877, set aside the Duck Valley Reservation for several Western Shoshoni bands that traditionally lived along the Owyhee River of southeastern Oregon, southwestern Idaho, and the Humbolt River of northeastern Nevada. Later, Paiute from the lower Weiser country of Idaho and other Northern Paiute families joined the Shoshoni on the

reservation. The reservation was expanded in 1886 to a half million acres to include a Northern Paiute group (Paddy Cap's Band), who arrived in 1884 following their release from the Yakama Reservation. The current reservation is of 294,242 acres. The entire reservation is owned by the tribe, forming a contiguous block of property located partially in southwestern Idaho and partially in northern Nevada.

The tribe adopted a constitution in 1936 in conformance with the Howard-Wheeler Act of 1934. The tribe is one of the original 17 tribes that achieved a self-governing status, having shed BIA's supervision. The tribe has General Council meetings of adult tribal members and a six-member elected Tribal Council. Tribal headquarters are in Owyhee, Nevada. Western Shoshone and Northern Paiute peoples are represented on the reservation. Traditional religious beliefs and Christian denominations form the tribe's primary religious affiliations.

5.13 The Spokane Tribe of the Spokane Reservation

The Executive Order of January 18, 1881, and subsequent agreements and acts form the basis for the Spokane tribe's sovereignty. The first reservation was established in 1881 in northeast Washington. Today the reservation comprises 137,002 acres of fee, allotted, and trust lands. The tribe approved a constitution in May 1951, establishing a Business Council. Today a general election chooses a five-member General Council, which then elects members to the Business Council. At least once a year adult tribal members meet to advise the General Council. The tribe is self-governing. Tribal headquarters are in Wellpinit, Washington.

Peoples represented by the tribe are of the Northern Plateau and represent Upper Spokane (Snxwemi'ne: people of the steelhead trout place); Middle Spokane (Sqasi'lni: fishers, after a village name); Lower Spokane (Sineka'lt: rapids, after a village name); and Chewelah groups. Major religious affiliations are Christian denominations, primarily Catholic. English and Interior Salish are spoken by the tribe.

5.14 Wanapum Band

The Wanapum Band today is a traditional Indian community that lives along the middle Columbia River within their native homeland. The community is comprised of a longhouse and families that follow traditional social, subsistence, and religious customs while having adapted to modern societal and economic demands. The Wanapum people believe that their Creator gave them the land as a sacred trust and would not take it away from them. The families who live at Priest Rapids maintain the responsibility to address concerns on their ancestral homeland. The Wanapum have never left their homeland because of the sacred trust, and their responsibilities as handed down to them by their elders.

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6. Regional Coordination

6.1 Forum Process

The Lower Snake River Feasibility Study has participated in many of the ongoing regional processes, coordinating with other Federal agencies, tribes, and interested regional parties in matters related to the salmon issues. The Corps has also coordinated with other affected tribes, bands, and other interested parties on a host of other concerns and issues that relate to proposed alternative pathways addressed in the Feasibility Study. This is an ongoing effort that will continue throughout the planning and implementation stages of the Feasibility Study and EIS. See Appendix O, Public Outreach Program, for further information on this subject.

The following are examples of these regional organizations and not intended to be an inclusive listing.

6.2 Regional Forum

The Regional Forum was created by the National Marine Fisheries Service (NMFS) in 1996 to coordinate the implementation of programs (primarily the 1995 Biological Opinion [NMFS, 1995]) for at-risk Snake River salmon stocks with other programs for fish and wildlife, primarily the Northwest Power Planning Council, throughout the Columbia Basin. The tribes participated in this forum along with other interested parties. However, the tribes subsequently withdrew from active participation and threw their support to the Framework process, now known as the Columbia Basin Forum.

The Regional Forum is one of many regional activities within which the Corps has coordinated the Feasibility Study. Its basic structure is shown below:

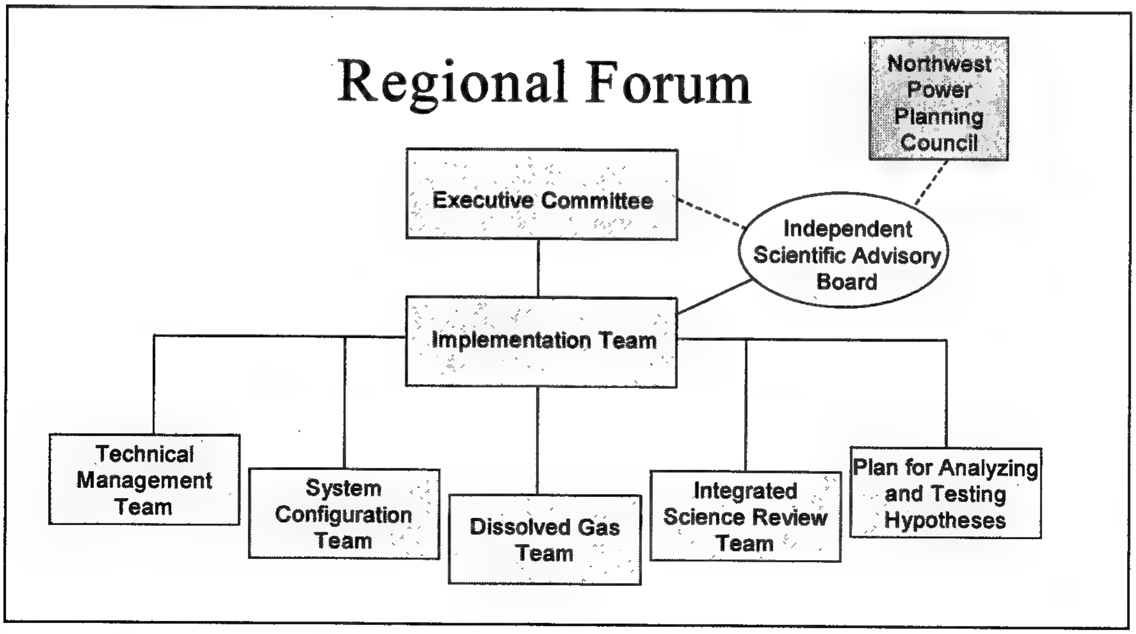

Figure 6-1. Regional Forum

6.3 Columbia Basin Forum

The Columbia Basin Forum is made up of representatives from the four Northwest states, the 14 Columbia Basin Tribes, and the Federal agencies involved in the Columbia River. Its purpose is to provide a high-level policy forum to coordinate the use of its members' respective authorities in addressing fish and wildlife management and related habitat issues in the Columbia Basin. This forum provides a place for governments and interested parties in the region to discuss alternative management approaches to the basin and test regional agreement on the various alternatives.

6.4 The Multi-Species Framework

The Northwest region's governments and stakeholders are working to develop and analyze alternative management plans for the Columbia River Basin. This regional effort is being coordinated through the Multi-Species Framework project and the Columbia Basin Forum. Participants include state governments, tribal governments and Federal agencies, with a management committee representing all three entities. The Framework aims to develop a science-based vision for Columbia Basin fish and wildlife management that recognizes the interrelated parts of the basin's ecosystem. The state governments, tribal governments, and Federal agencies expect the Framework to guide the development of the Federal Columbia River Power System (FCRPS) alternatives, including the lower Snake River, by providing information on the likely biological, social, and economic outcomes of those alternatives.

6.5 Federal Caucus

Nine Federal agencies are involved in various aspects of management of the Columbia River. Several of these Federal agencies will be involved in the Endangered Species Act (ESA) consultations on operation and configuration of the FCRPS. These Federal agencies have a specific statutory responsibility under the ESA, including the preparation of a Biological Assessment and a Biological Opinion for listed species. To ensure coordination and effective representation in the Framework and Forum, and to prepare for this ESA consultation, the Federal agencies formed a Federal Caucus.

6.6 Tribal Caucus

The 14 Indian tribes in the Columbia Basin represent sovereign entities with management authorities for fish, water, and wildlife resources within their reservations, as well as various legal rights that extend off-reservation as expressed in treaties and executive orders.

To ensure coordination and effective representation in the Framework and Forum, the tribes have formed a Tribal Caucus. The Tribal Caucus serves to identify consensus between participating tribes where it exists. The Federal and Tribal caucuses will provide key mechanisms for communications between the Federal agencies and the tribes.

6.7 Columbia River Inter-Tribal Fish Commission

The United States entered into several treaties with Columbia River tribes (see Annex A). A key provision in these treaties was the exclusive right of Indians to take fish at usual and accustomed places, in common with citizens of the United States, from streams running through and bordering on reservation land. These treaty fishing rights were supported and clarified in several court decisions, including *Sohappy v. Smith* (1969), the *United States v. Oregon* (1969) and *United States v. Washington* (1974). The *United States v. Washington* decision found that Indian treaty fishermen are entitled to take up to one-half of harvestable salmon and steelhead that return to usual and accustomed places. A 5-year management and allocation agreement for upper Columbia River fish runs was approved in 1977, and parties to *United States v. Oregon* agreed to cooperatively pursue and promote fish habitat and hatchery rearing programs in the upper Columbia Basin. In August 1977, four tribes that were parties to *United States v. Oregon* established the Columbia River Inter-Tribal Fish Commission. The Commission presents a strong, unified tribal voice as a technical advocacy group and provides a venue where tribes and Federal agencies can communicate regarding issues and alternatives associated with fisheries habitat management and the natural environment.

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7. Feasibility Study Consultation and Coordination with Affected Tribes and Bands

Tribal consultation on the Lower Snake River Juvenile Salmon Migration Feasibility Study (Feasibility Study) was initiated in July 1997, when the Walla Walla District hosted a meeting with the region's tribes to discuss tribal coordination and formal consultation for the Feasibility Study process. At the July meeting, the participants agreed to a consultation process that included periodic status letters from the Corps and also provided the tribes the opportunity to review and comment on the various components of the study. Those agreements and the proposed consultation milestones throughout the remainder of the study were identified in a letter to the tribes dated April 7, 1998. The Corps also agreed to followup meetings as a part of the continuing consultation process.

A second tribal consultation meeting was hosted by the Corps of Engineers in Walla Walla on August 19, 1998. Information concerning the nature of the Feasibility Study and the status of its Draft Environmental Impact Statement (DEIS) appendices/reports was shared with tribal representatives from the affected tribes of the Colville, Shoshone-Paiute, and Umatilla indian reservations. The Corps clarified that the meeting was intended as an opportunity to consult with some affected tribes and that formal consultation would occur prior to the release of the DEIS. The issues raised at the meeting included the following: a) how and at what cost might existing hydropower facility equipment be removed/salvaged; b) obligations concerning property rights for livestock-watering corridors; c) the need to consider EIS effects on Palous band's interests; d) dam-breaching effects on river sediment levels and remedies; and e) the findings of how effective facility surface bypass equipment would be to divert fish away from dam turbines at Lower Granite Dam.

The Corps of Engineers hosted a third tribal consultation meeting in Richland, Washington, on February 22, 1999. The meeting was arranged to share technical information and discuss policy issues related to the Feasibility Study. Representatives from the Umatilla and Nez Perce reservations and the Wanapum community attended the meeting. These representatives advised the Corps to consult in the future with affected tribes on an individual basis concerning the Feasibility Study. Tribal concerns discussed at the meeting included the following: a) political influences on the decision-making process; b) limited value of the analysis concerning transporting anadromous fish in barges past dam facilities; c) need for implications of treaty rights to be fully examined in the DEIS; d) concern for adult fish passage problems through bypass features at dams; e) how tribes will be permitted opportunities to review DEIS appendices; and f) drawdown alternative costs to modify Potlatch facility in Idaho in case compliance with water quality standards is necessary for the lower Snake River. The tribe also requested that the Feasibility Study examine Executive orders 13007 (Sacred Sites) and 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations).

The CTUIR requested a formal consultation meeting with the Corps in a letter dated February 22, 1999, to Col. Eric Mogren. In response, a meeting took place in Mission, Oregon, on May 12, 1999. The tribe presented seven points it expects the Corps to deal with in consultation with the

CTUIR, including the protection of treaty rights, trust resources, and natural/cultural resources, and preventing the extinction of salmonids and Pacific lamprey. The tribe's general council chairman stressed the importance of the tribe's treaty rights; the agency-tribe consultation process; the cultural significance of fish species and their importance in contributing to the tribe's quality of life; and the Corps' trust responsibilities toward the tribe. A copy of the tribe's consultation process and protocols was given to the Corps.

Tribal concerns expressed at the May 12 meeting include the following: a) effects on tribal treaty rights from agency decision-making and need for collaborative management to recover anadromous fish species; b) lack of agency-tribe consultation in past for several salmonid-recovery planning efforts to restore aquatic habitats; c) cost of breaching lower Snake River dams; d) need for long-term management planning for cultural resources, and environmental rehabilitation plan for a drawdown alternative; e) lessons learned from other dam-removal cases; f) how effects on Pacific lamprey are being addressed; and g) need to address the carrying capacity of the Snake River System and human uses. The Corps presented information concerning the Feasibility Study, economic reports, and the John Day Dam drawdown study. A copy of the Northwestern Division Native American Policy was given to the tribe.

On July 16, 1998, representatives from the Walla Walla District of the Corps presented information on the nature and status of the Feasibility Study to the Shoshone-Bannock Tribal Council on the Fort Hall Reservation. Both the economic and tribal circumstances report updates were provided. Tribal representatives expressed the point that the Federal understanding of cultural resources did not include both natural and cultural resources, which the tribe wanted to be viewed together in light of its interests and rights. Other topics discussed included the upper Snake River flow augmentation and its possible effects on the lower Snake River, and concerns for anadromous fish populations.

Shoshone-Bannock Council members and representatives from the Walla Walla District of the Corps met at the Fort Hall Business Council Center in Fort Hall, Idaho, on April 13, 2000, to discuss the Feasibility Study. Council members strongly urged breaching of the dams and trucking fish instead of barging them. They also raised concerns about preservation of treaty rights and their way of life, both of which they considered to be jeopardized by the length of time being used to complete the Study. Other topics discussed included cost displays (there being no way to place a price tag on life), failure of the Study to address true tribal impacts and costs associated with the lack of access to fish and their way of life, and the large investments in fish passage system improvements since the latter could cloud a decision to breach the dams.

Information sharing and coordination efforts with affected tribes also include the following:

- Tribal Reviews of DEIS Appendices—In May 1999, copies of the outline for the Cultural Resources Appendix were distributed to the five participating tribes and one band of the Walla Walla District's Payos Kuus Ts'uukwe tribal cooperating group for review.
- The Tribal Circumstances and Impacts of the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs and Shoshone Bannock Tribes (Meyer Resources, 1999) has been reviewed by the Columbia River Inter-Tribal Fish Commission and the five study tribes discussed in the report. In addition, copies of the report were distributed in mid-September 1999 to the full 14 tribes that may be affected by decisions in the FR/EIS.

- Future Consultation—The Corps is seeking input from tribes on how they want the Corps to fulfill government-to-government consultation for the Feasibility Study. The Corps plans on either additional consultation meetings with affected tribes or consultation meetings with individual tribes.
- The issues addressed in the Feasibility Study have also been discussed in other venues and forums. Representatives of eight Federal agencies and Northwest Indian tribes have shared opinions about many important issues including sovereignty, treaty rights, salmon preservation and recovery, hatcheries, access to fishing locations, harvest decisions, habitat management, hydroelectric operations, fish and wildlife mitigation in the Columbia River Basin, and cultural resources.

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8. Literature Cited

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9. Glossary

Ceded lands: Land formally granted, as through a treaty agreement, from one government (an American Indian tribe) to another government (the United States Government). In the case of ceded lands within the lower Snake River basin, responsible tribes transferred all right and title in lands held by their peoples to the United States through treaties.

Culture Area: A term in anthropology used to identify a group of distinct cultures that share common cultural traits. Usually such cultures share a geographical region defined by the extent of their territories.

Executive Order: The term refers to orders of the Chief Executive (the President of the United States). Executive orders have historically included the setting aside of land within the boundaries of the United States from general settlement, or the establishment of a particular land use through public laws. For example, the Confederated Tribes of the Colville Reservation were Federally recognized and their reservation established through executive orders.

Treaty: An agreement or contract between two or more nations or sovereigns, formally signed by commissioners properly authorized, and solemnly ratified by the participating sovereigns or the supreme power of each state. A treaty is not only a law, but a contract between two nations and must, if possible, have all its parts given full force and effect (Black's Law Dictionary, 1968).

Tribe: An American Indian tribe, band, nation, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe pursuant to the Federally Recognized Tribe List Act of 1994, 25 U.S.C. 479a.

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ANNEX A

Treaties

1855—June 9 Treaty with the Yakima (12 Stat. 951 et seq)
1855—June 9 Treaty with the Walla Walla, Cayuse, and Umatilla (12 Stat. 945 et seq)
1855—June 11 Treaty with the Nez Perces (12 Stat. 957)
1855—July 16 Treaty with Flathead, Kootenai, and Upper Pend d'Oreilles (12 Stat. 975)
1855—July 25 Treaty with Tribes of Middle Oregon (12 Stat. 963)
1863—June 9 Treaty with the Nez Perces (14 Stat. 647)
1863—July 2 Treaty with the Eastern Shoshoni Tribe (18 Stat. 685)
1865—August 12 Treaty with the Snake (14 Stat. 683)
1868—August 13 Treaty with the Nez Perces (15 Stat. 693)
1868—July 3 Treaty with the Eastern Band Shoshoni and Bannock (15 Stat. 673)

Note: The above treaties were appended from Kappler (1973).

TREATY WITH THE YAKIMA, 1855.

June 9, 1855.

12 Stat., 951.
Ratified Mar. 8, 1859.
Proclaimed Apr. 18, 1859.

Articles of agreement and convention made and concluded at the treaty-ground, Camp Stevens, Walla-Walla Valley, this ninth day of June, in the year one thousand eight hundred and fifty-five, by and between Isaac I. Stevens, governor and superintendent of Indian affairs for the Territory of Washington, on the part of the United States, and the undersigned head chiefs, chiefs, head-men, and delegates of the Yakama, Palouse, Pisquouse, Wenatshapam, Klikatat, Klinquit, Kow-was-say-ee, Li-ay-was, Skin-pah, Wish-ham, Shyiks, Oche-chotes, Kah-milt-pah, and Se-ap-cat, confederated tribes and bands of Indians, occupying lands hereinafter bounded and described and lying in Washington Territory, who for the purposes of this treaty are to be considered as one nation, under the name of "Yakama," with Kamaiakun as its head chief, on behalf of and acting for said tribes and bands, and being duly authorized thereto by them.

Cession of lands to the United States.

ARTICLE 1. The aforesaid confederated tribes and bands of Indians hereby cede, relinquish, and convey to the United States all their right, title, and interest in and to the lands and country occupied and claimed by them, and bounded and described as follows, to wit:

Boundaries.

Commencing at Mount Ranier, thence northerly along the main ridge of the Cascade Mountains to the point where the northern tributaries of Lake Che-lan and the southern tributaries of the Methow River have their rise; thence southeasterly on the divide between the waters of Lake Che-lan and the Methow River to the Columbia River; thence, crossing the Columbia on a true east course, to a point whose longitude is one hundred and nineteen degrees and ten minutes, (119° 10',) which two latter lines separate the above confederated tribes and bands from the Oakinakane tribe of Indians; thence in a true south course to the forty-seventh (47°) parallel of latitude; thence east on said parallel to the main Palouse River, which two latter lines of boundary separate the above confederated tribes and bands from the Spokanes; thence down the Palouse River to its junction with the Moh-hah-ne-she, or southern tributary of the same; thence in a southesterly direction, to the Snake River, at the mouth of the Tucannon River, separating the above confederated tribes from the Nez Percé tribe of Indians; thence down the Snake River to its junction with the Columbia River; thence up the Columbia River to the "White Banks" below the Priest's Rapids; thence westerly to a lake called "La Lac;" thence southerly to a point on the Yakama River called Toh-mah-luke; thence, in a southwesterly direction, to the Columbia River, at the western extremity of the "Big Island," between the mouths of the Umatilla River and Butler Creek; all which latter boundaries separate the

[Page 698]

above confederated tribes and bands from the Walla-Walla, Cayuse, and Umatilla tribes and bands of Indians; thence down the Columbia River to midway between the mouths of White Salmon and Wind Rivers; thence along the divide between said rivers to the main ridge of the Cascade Mountains; and thence along said ridge to the place of beginning.

Reservation.

ARTICLE 2. There is, however, reserved, from the lands above ceded for the use and occupation of the aforesaid confederated tribes and bands of Indians, the tract of land included within the following boundaries, to wit: Commencing on the Yakama River, at the mouth of the Attah-nam River; thence westerly along said Attah-nam River to the forks; thence along the southern tributary to the Cascade Mountains; thence southerly along the main ridge of said mountains, passing south and east of Mount Adams, to the spur whence flows the waters of the Klickatat and Pisco Rivers; thence down said spur to the divide between the waters of said rivers; thence along said divide to the divide separating the waters of the Satass River from those flowing into the Columbia River; thence along said divide to the main Yakama, eight miles below the mouth of the Satass River; and thence up the Yakama River to the place of beginning.

Boundaries.

Reservations to be set apart, etc., and Indians to settle thereon.

Whites not to reside thereon.

All which tract shall be set apart and, so far as necessary, surveyed and marked out, for the exclusive use and benefit of said confederated tribes and bands of Indians, as an Indian reservation; nor shall any white man, excepting those in the employment of the Indian Department, be permitted to reside upon the said reservation without permission of the tribe and the superintendent and agent. And the said confederated tribes and bands agree to remove to, and settle upon, the same, within one year after the ratification of this treaty. In the mean time it shall be lawful for them to reside upon any ground not in the actual claim and occupation of citizens of the United States; and upon any ground claimed or occupied, if with the permission of the owner or claimant.

Guaranteeing, however, the right to all citizens of the United States to enter upon and occupy as settlers any lands not actually occupied and cultivated by said Indians at this time, and not included in the reservation above named.

Improvements on ceded lands.

And provided, That any substantial improvements heretofore made by any Indian, such as fields enclosed and cultivated, and houses erected upon the lands hereby ceded, and which he may be compelled to abandon in consequence of this treaty, shall be valued, under the direction of the President of the United States, and payment made therefor in money; or improvements of an equal value made for said Indian upon the reservation. And no Indian will be required to abandon the improvements aforesaid, now occupied by him, until their value in money, or improvements of an equal value shall be furnished him as aforesaid.

Roads may be made.

ARTICLE 3. *And provided*, That, if necessary for the public convenience, roads may be run through the said reservation; and on the other hand, the right of way, with free access from the same to the nearest public highway, is secured to them; as also the right, in common with citizens of the United States, to travel upon all public highways.

Privileges secured to Indians.

The exclusive right of taking fish in all the streams, where running through or bordering said reservation, is further secured to said confederated tribes and bands of Indians, as also the right of taking fish at all usual and accustomed places, in common with the citizens of the Territory, and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land.

[Page 699]

Payments by the United States.

ARTICLE 4. In consideration of the above cession, the United States agree to pay to the said confederated tribes and bands of Indians, in addition to the goods and provisions distributed to them at the time of signing this treaty, the sum of two hundred thousand dollars, in the following manner, that is to say: Sixty thousand dollars, to be expended under the direction of the President of the United States, the first year after the ratification of this treaty, in providing for their removal to the reservation, breaking up and fencing farms, building houses for them, supplying them with provisions and a suitable outfit, and for such other objects as he may deem necessary, and the remainder in annuities, as follows: For the first five years after the ratification of the treaty, ten thousand dollars each year, commencing September first, 1856; for the next five years, eight thousand dollars each year; for the next five years, six thousand dollars per year; and for the next five years, four thousand dollars per year.

How to be applied.

All which sums of money shall be applied to the use and benefit of said Indians, under the direction of the President of the United States, who may from time to time determine, at his discretion, upon what beneficial objects to expend the same for them. And the superintendent of Indian affairs, or other proper officer, shall each year inform the President of the wishes of the Indians in relation thereto.

United States to establish schools.

ARTICLE 5. The United States further agree to establish at suitable points within said reservation, within one year after the ratification hereof, two schools, erecting the necessary buildings, keeping them in repair, and providing them with furniture, books, and stationery, one of which shall be an agricultural and industrial school, to be located at the agency, and to be free to the children of the said confederated tribes and bands of Indians, and to employ one superintendent of teaching and two teachers; to build two blacksmiths' shops, to one of which shall be attached a tin-shop, and to the other a gunsmith's shop; one carpenter's shop, one wagon and plough maker's shop, and to keep the same in repair and furnished with the necessary tools; to employ one superintendent of farming and two farmers, two blacksmiths, one tinner, one gunsmith, one carpenter, one wagon and plough maker, for the instruction of the Indians in trades and to assist them in the same; to erect one saw-mill and one flouring-mill, keeping the same in repair and furnished with the necessary tools and fixtures; to erect a hospital, keeping the same in repair and provided with the necessary medicines and furniture, and to employ a physician; and to erect, keep in repair, and provided with the necessary furniture, the building required for the accommodation of the said employees. The said buildings and establishments to be maintained and kept in repair as aforesaid, and the employees to be kept in service for the period of twenty years.

Mechanics' shops.

Sawmill and flouring mill.
Hospital.

Salary to head chief; house, etc.

And in view of the fact that the head chief of the said confederated tribes and bands of Indians is expected, and will be called upon to perform many services of a public character, occupying much of his time, the United States further agree to pay to the said confederated tribes and bands of Indians five hundred dollars per year, for the term of twenty years after the ratification hereof, as a salary for such person as the said confederated tribes and bands of Indians may select to be their head chief, to build for him at a suitable point on the reservation a comfortable house, and properly furnish the same, and to plough and fence ten acres of land. The said salary to be paid to, and the said house to be occupied by, such head chief so long as he may continue to hold that office.

Kamaiakun is the head chief.

And it is distinctly understood and agreed that at the time of the conclusion of this treaty Kamaiakun is the duly elected and authorized

[Page 700]

head chief of the confederated tribes and bands aforesaid, styled the Yakama Nation, and is recognized as such by them and by the commissioners on the part of the United States holding this treaty; and all the expenditures and expenses contemplated in this article of this treaty shall be defrayed by the United States, and shall not be deducted from the annuities agreed to be paid to said confederated tribes and band of Indians. Nor shall the cost of transporting the goods for the annuity payments be a charge upon the annuities, but shall be defrayed by the United States.

Reservation may be surveyed into lots and assigned to individuals or families.

ARTICLE 6. The President may, from time to time, at his discretion, cause the whole or such portions of such reservation as he may think proper, to be surveyed into lots, and assign the same to such individuals or families of the said confederated tribes and bands of Indians as are willing to avail themselves of the privilege, and will locate on the same as a permanent home, on the same terms and subject to the same regulations as are provided in the sixth article of the treaty with the Omahas, so far as the same may be applicable.

Annuities not to pay for debts of individuals.

ARTICLE 7. The annuities of the aforesaid confederated tribes and bands of Indians shall not be taken to pay the debts of individuals.

Tribes to preserve friendly relations.

ARTICLE 8. The aforesaid confederated tribes and bands of Indians acknowledge their dependence upon the Government of the United States, and promise to be friendly with all citizens thereof, and pledge themselves to commit no depredations upon the property of such citizens.

To pay for depredations.

And should any one or more of them violate this pledge, and the fact be satisfactorily proved before the agent, the property taken shall be returned, or in default thereof, or if injured or destroyed, compensation may be made by the Government out of the annuities.

Not to make war but in self-defense.

Nor will they make war upon any other tribe, except in self-defence, but will submit all matters of difference between them and other Indians to the Government of the United States or its agent for decision, and abide thereby. And if any of the said Indians commit depredations on any other Indians within the Territory of Washington or Oregon, the same rule shall prevail as that provided in this article in case of depredations against citizens. And the said confederated tribes and bands of Indians agree not to shelter or conceal offenders against the laws of the United States, but to deliver them up to the authorities for trial.

To surrender offenders.

Annuities may be withheld from those who drink ardent spirits.

ARTICLE 9. The said confederated tribes and bands of Indians desire to exclude from their reservation the use of ardent spirits, and to prevent their people from drinking the same, and, therefore, it is provided that any Indian belonging to said confederated tribes and bands of Indians, who is guilty of bringing liquor into said reservation, or who drinks liquor, may have his or her annuities withheld from him or her for such time as the President may determine.

Wenatshapam fishery reserved.

ARTICLE 10. *And provided*, That there is also reserved and set apart from the lands ceded by this treaty, for the use and benefit of the aforesaid confederated tribes and bands, a tract of land not exceeding in quantity one township of six miles square, situated at the forks of the Pisquouse or Wenatshapam River, and known as the "Wenatshapam Fishery," which said reservation shall be surveyed and marked out whenever the President may direct, and be subject to the same provisions and restrictions as other Indian reservations.

When treaty to take effect.

ARTICLE 11. This treaty shall be obligatory upon the contracting parties as soon as the same shall be ratified by the President and Senate of the United States.

In testimony whereof, the said Isaac I. Stevens, governor and superintendent of Indian affairs for the Territory of Washington, and the undersigned head chief, chiefs, headmen, and delegates of the afore-

[Page 701]

said confederated tribes and bands of Indians, have hereunto set their hands and seals, at the place and on the day and year hereinbefore written.

ISAAC I. STEVENS,
Governor and Superintendent. [L. S.]

Kamaiakun, his x mark.	[L. S.]	Wish-och-kmpits, his x mark.	[L. S.]
Skloom, his x mark.	[L. S.]	Koo-lat-toose, his x mark.	[L. S.]
Owhi, his x mark.	[L. S.]	Shee-ah-cotte, his x mark.	[L. S.]
Te-cole-kun, his x mark.	[L. S.]	Tuck-quille, his x mark.	[L. S.]
La-hoom, his x mark.	[L. S.]	Ka-loo-as, his x mark.	[L. S.]
Me-ni-nock, his x mark.	[L. S.]	Scha-noo-a, his x mark.	[L. S.]
Elit Palmer, his x mark.	[L. S.]	Sla-kish, his x mark.	[L. S.]

Signed and sealed in the presence of—

James Doty, secretary of treaties,
Mie. Cles. Pandosy, O. M. T.,
Wm. C. McKay,
W. H. Tappan, sub Indian agent, W. T.,
C. Chirouse, O. M. T.,
Patrick McKenzie, interpreter,
A. D. Pamburn, interpreter,
Joel Palmer, superintendent Indian affairs, O. T.,
W. D. Biglow,
A. D. Pamburn, interpreter.

[Page 702]

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TREATY WITH THE WALLAWALLA, CAYUSE, ETC., 1855.

June 9, 1855.

12 Stats., 945.
Ratified Mar. 8, 1859.
Proclaimed Apr. 11, 1859.

Articles of agreement and convention made and concluded at the treaty-ground, Camp Stevens, in the Walla-Walla Valley, this ninth day of June, in the year one thousand eight hundred and fifty-five, by and between Isaac I. Stevens, governor and superintendent of Indian affairs for the Territory of Washington, and Joel Palmer, superintendent of Indian affairs for Oregon Territory, on the part of the United States, and the undersigned chiefs, head-men, and delegates of the Walla-Wallas, Cayuses, and Umatilla tribes, and bands of Indians, occupying lands partly in Washington and partly in Oregon Territories, and who, for the purposes of this treaty, are to be regarded as one nation acting for and in behalf of their respective bands and tribes, they being duly authorized thereto; it being understood that Superintendent I. I. Stevens assumes to treat with that portion of the above-named bands and tribes residing within the Territory of Washington, and Superintendent Palmer with those residing within Oregon.

Cession of lands to the United States.

Boundaries.

ARTICLE 1. The above-named confederated bands of Indians cede to the United States all their right, title, and claim to all and every part of the country claimed by them included in the following boundaries, to wit: Commencing at the mouth of the Tocannon River, in Washington Territory, running thence up said river to its source; thence easterly along the summit of the Blue Mountains, and on the southern boundaries of the purchase made of the Nez Percés Indians, and easterly along that boundary to the western limits of the country claimed by the Shoshonees or Snake Indians; thence southerly along that boundary (being the waters of Powder River) to the source of Powder River, thence to the head-waters of Willow Creek, thence down Willow Creek to the Columbia River, thence up the channel of the Columbia River to the lower end of a large island below the mouth of Umatilla River, thence northerly to a point on the Yakama River, called Tomah-luke, thence to Le Lac, thence to the White Banks on the Columbia below Priest's Rapids, thence down the Columbia River to the junction of the Columbia and Snake Rivers, thence up the Snake River to the place of beginning: *Provided, however,* That so much of the country described above as is contained in the following boundaries shall be set apart as a residence for said Indians, which tract for the purposes contemplated shall be held and regarded as an Indian reservation; to wit: Commencing in the middle of the channel of Umatilla River opposite the mouth of Wild Horse Creek, thence up the middle of the channel of said creek to its source, thence southerly to a point in the Blue Mountains, known as Lee's Encampment, thence in a line to the head-waters of Howtome Creek, thence west to the divide between Howtome and Birch Creeks, thence northerly along said divide to a point due west of the southwest corner of William C. McKay's land-claim, thence east along his line to his southeast corner, thence in a line to the place of beginning; all of which tract shall be set apart and, so far as necessary, surveyed and marked out for their exclusive use; nor shall any white person be permitted to reside upon the same without permission of the agent and superintendent. The said tribes and bands agree to remove to and settle upon the same within one year after the ratification of this treaty, without any additional expense to the Government other than is provided by this treaty, and until the expiration of the time specified, the said bands shall be permitted to occupy and reside upon the tracts now possessed by them, guaranteeing to all citizen[s] of the United States, the right to enter upon and occupy as settlers any lands not actually enclosed by said Indians: *Provided, also,* That the exclusive right of taking fish in the streams running through and bordering said reservation is hereby

Boundaries.

Reservation.

Whites not to reside thereon, unless, etc.

Tribes to settle thereon in a year.

Rights and privileges secured to the Indians.

[Page 694]

secured to said Indians, and at all other usual and accustomed stations in common with citizens of the United States, and of erecting suitable buildings for curing the same; the privilege of hunting, gathering roots and berries and pasturing their stock on unclaimed lands in common with citizens, is also secured to them. *And provided, also*, That if any band or bands of Indians, residing in and claiming any portion or portions of the country described in this article, shall not accede to the terms of this treaty, then the bands becoming parties hereunto agree to reserve such part of the several and other payments herein named, as a consideration for the entire country described as aforesaid, as shall be in the proportion that their aggregate number may have to the whole number of Indians residing in and claiming the entire country aforesaid, as consideration and payment in full for the tracts in said country claimed by them. *And provided, also*, That when substantial improvements have been made by any member of the bands being parties to this treaty, who are compelled to abandon them in consequence of said treaty, [they] shall be valued under the direction of the President of the United States, and payment made therefor.

Proviso in case any tribe does not accede to this treaty.

Allowance for improvements, if, etc.

ARTICLE 2. In consideration of and payment for the country hereby ceded, the United States agree to pay the bands and tribes of Indians claiming territory and residing in said country, and who remove to and reside upon said reservation, the several sums of money following, to wit: eight thousand dollars per annum for the term of five years, commencing on the first day of September, 1856; six thousand dollars per annum for the term of five years next succeeding the first five; four thousand dollars per annum for the term of five years next succeeding the second five, and two thousand dollars per annum for the term of five years next succeeding the third five; all of which several sums of money shall be expended for the use and benefit of the confederated bands herein named, under the direction of the President of the United States, who may from time to time at his discretion, determine what proportion thereof shall be expended for such objects as in his judgment will promote their well-being, and advance them in civilization, for their moral improvement and education, for buildings, opening and fencing farms, breaking land, purchasing teams, wagons, agricultural implements and seeds, for clothing, provision and tools, for medical purposes, providing mechanics and farmers, and for arms and ammunition.

Payments by the United States.

How to be expended.

ARTICLE 3. In addition to the articles advanced the Indians at the time of signing this treaty, the United States agree to expend the sum of fifty thousand dollars during the first and second years after its ratification, for the erection of buildings on the reservation, fencing and opening farms, for the purchase of teams, farming implements, clothing, and provisions, for medicines and tools, for the payment of employés, and for subsisting the Indians the first year after their removal.

United States to expend $50,000 for buildings, etc.

ARTICLE 4. In addition to the consideration above specified, the United States agree to erect, at suitable points on the reservation, one saw-mill, and one flouring-mill, a building suitable for a hospital, two school-houses, one blacksmith shop, one building for wagon and plough maker and one carpenter and joiner shop, one dwelling for each, two millers, one farmer, one superintendent of farming operations, two school-teachers, one blacksmith, one wagon and plough maker, one carpenter and joiner, to each of which the necessary out-buildings. To purchase and keep in repair for the term of twenty years all necessary mill fixtures and mechanical tools, medicines and hospital stores, books and stationery for schools, and furniture for employés.

To erect sawmills, schools, mechanics' shops, etc.

The United States further engage to secure and pay for the services and subsistence, for the term of twenty years, [of] one superintendent of farming operations, one farmer, one blacksmith, one wagon and plough maker, one carpenter and joiner, one physician, and two school-teachers.

To employ mechanics, teachers, etc.

[Page 695]

To build dwelling houses, etc., for head chiefs.

ARTICLE 5. The United States further engage to build for the head chiefs of the Walla-Walla, Cayuse, and Umatilla bands each one dwelling-house, and to plough and fence ten acres of land for each, and to pay to each five hundred dollars per annum in cash for the term of twenty years. The first payment to the Walla-Walla chief to commence upon the signing of this treaty. To give to the Walla-Walla chief three yoke of oxen, three yokes and four chains, one wagon, two ploughs, twelve hoes, twelve axes, two shovels, and one saddle and bridle, one set of wagon-harness, and one set of plough-harness, within three months after the signing of this treaty.

Pio-pio-mox-mox.

To build for the son of Pio-pio-mox-mox one dwelling-house, and plough and fence five acres of land, and to give him a salary for twenty years, one hundred dollars in cash per annum, commencing September first, eighteen hundred and fifty-six.

The improvement named in this section to be completed as soon after the ratification of this treaty as possible.

It is further stipulated that Pio-pio-mox-mox is secured for the term of five years, the right to build and occupy a house at or near the mouth of Yakama River, to be used as a trading-post in the sale of his bands of wild cattle ranging in that district: *And provided, also*, That in consequence of the immigrant wagon-road from Grand Round to Umatilla, passing through the reservation herein specified, thus leading to turmoils and disputes between Indians and immigrants, and as it is known that a more desirable and practicable route may be had to the south of the present road, that a sum not exceeding ten thousand dollars shall be expended in locating and opening a wagon-road from Powder River or Grand Round, so as to reach the plain at the western base of the Blue Mountain, south of the southern limits of said reservation.

$10,000 to be expended for opening wagon road from Powder River.

Allotments of land may be made to individual Indians.

ARTICLE 6. The President may, from time to time at his discretion cause the whole or such portion as he may think proper, of the tract that may now or hereafter be set apart as a permanent home for those Indians, to be surveyed into lots and assigned to such Indians of the confederated bands as may wish to enjoy the privilege, and locate thereon permanently, to a single person over twenty-one years of age, forty acres, to a family of two persons, sixty acres, to a family of three and not exceeding five, eighty acres; to a family of six persons and not exceeding ten, one hundred and twenty acres; and to each family over ten in number, twenty acres to each additional three members; and the President may provide for such rules and regulations as will secure to the family in case of the death of the head thereof, the possession and enjoyment of such permanent home and improvement thereon; and he may at any time, at his discretion, after such person or family has made location on the land assigned as a permanent home, issue a patent to such person or family for such assigned land, conditioned that the tract shall not be aliened or leased for a longer term than two years, and shall be exempt from levy, sale, or forfeiture, which condition shall continue in force until a State constitution, embracing such land within its limits, shall have been formed and the legislature of the State shall remove the restriction: *Provided, however*, That no State legislature shall remove the restriction herein provided for without the consent of Congress: *And provided, also*, That if any person or family, shall at any time, neglect or refuse to occupy or till a portion of the land assigned and on which they have located, or shall roam from place to place, indicating a desire to abandon his home, the President may if the patent shall have been issued, cancel the assignment, and may also withhold from such person or family their portion of the annuities or other money due them, until they shall have returned to such permanent home, and resumed the pursuits of industry, and in default of their return the tract may be declared

Patents may issue therefor. Conditions.

Restrictions not to be removed, unless, etc.

Assignments of patents may be canceled.

[Page 696]

abandoned, and thereafter assigned to some other person or family of Indians residing on said reservation: *And provided, also*, That the head chiefs of the three principal bands, to wit, Pio-pio-mox-mox, Weyatenatemany, and Wenap-snoot, shall be secured in a tract of at least one hundred and sixty acres of land.

Certain head chiefs to have 160 acres.

ARTICLE 7. The annuities of the Indians shall not be taken to pay the debts of individuals.

Annuities of Indians not to pay debts of individuals.

ARTICLE 8. The confederated bands acknowledge their dependence on the Government of the United States and promise to be friendly with all the citizens thereof, and pledge themselves to commit no depredation on the property of such citizens, and should any one or more of the Indians violate this pledge, and the fact be satisfactorily proven before the agent, the property taken shall be returned, or in default thereof, or if injured or destroyed, compensation may be made by the Government out of their annuities; nor will they make war on any other tribe of Indians except in self-defense, but submit all matter of difference between them and other Indians, to the Government of the United States or its agents for decision, and abide thereby; and if any of the said Indians commit any depredations on other Indians, the same rule shall prevail as that prescribed in the article in case of depredations against citizens. Said Indians further engage to submit to and observe all laws, rules, and regulations which may be prescribed by the United States for the government of said Indians.

Bands to preserve friendly relations.

To pay for depredations.

Not to make war, except, etc.

To submit to regulations.

ARTICLE 9. In order to prevent the evils of intemperance among said Indians, it is hereby provided that if any one of them shall drink liquor, or procure it for others to drink, [such one] may have his or her proportion of the annuities withheld from him or her for such time as the President may determine.

Annuities withheld from those drinking liquor.

ARTICLE 10. The said confederated bands agree that, whenever in the opinion of the President of the United States the public interest may require it, *that* all roads highways and railroads shall have the right of way through the reservation herein designated or which may at any time hereafter be set apart as a reservation for said Indians.

Right of way reserved for roads through reservation.

ARTICLE 11. This treaty shall be obligatory on the contracting parties as soon as the same shall be ratified by the President and Senate of the United States.

When treaty to take effect.

In testimony whereof, the said I. I. Stevens and Joel Palmer, on the part of the United States, and the undersigned chiefs, headmen, and delegates of the said confederated bands, have hereunto set their hands and seals, this ninth day of June, eighteen hundred and fifty-five.

Isaac I. Stevens, [L. S.]
Governor and Superintendent Washington Territory.

Joel Palmer, [L. S.]
Superintendent Indian Affairs, O. T.

Pio-pio-mox-mox, his x mark, head chief of Walla-Wallas. [L. S.]
Meani-teat or Pierre, his x mark. [L. S.]
Weyatenatemany, his x mark, head chief of Cayuses. [L. S.]
Wenap-snoot, his x mark, head chief of Umatilla. [L. S.]
Kamaspello, his x mark. [L. S.]
Steachus, his x mark. [L. S.]
Howlish-wampo, his x mark. [L. S.]
Five Crows, his x mark. [L. S.]
Stocheania, his x mark. [L. S.]
Mu-howlish, his x mark. [L. S.]
Lin-tin-met-cheania, his x mark. [L. S.]
Petamyo-mox-mox, his x mark. [L. S.]
Watash-te-waty, his x mark. [L. S.]
She-yam-na-kon, his x mark. [L. S.]
Qua-chim, his x mark. [L. S.]
Te-walca-temany, his x mark. [L. S.]
Keantoan, his x mark. [L. S.]
U-wait-quaick, his x mark. [L. S.]
Tilch-a-waix, his x mark. [L. S.]
La-ta-chin, his x mark. [L. S.]
Kacho-rolich, his x mark. [L. S.]
Kanocey, his x mark. [L. S.]
Som-na-howlish, his x mark. [L. S.]
Ta-we-way, his x mark. [L. S.]
Ha-hats-me-cheat-pus, his x mark. [L. S.]
Pe-na-cheanit, his x mark. [L. S.]
Ha-yo-ma-kin, his x mark. [L. S.]
Ya-ca-lox, his x mark. [L. S.]
Na-kas, his x mark. [L. S.]
Stop-cha-yeou, his x mark. [L. S.]
He-yeau-she-keaut, his x mark. [L. S.]
Sha-wa-way, his x mark. [L. S.]
Tam-cha-key, his x mark. [L. S.]
Te-na-we-na-cha, his x mark. [L. S.]
Johnson, his x mark. [L. S.]
Whe-la-chey, his x mark. [L. S.]

[Page 697]

Signed in the presence of—

James Doty, secretary treaties.
Wm. C. McKay, secretary treaties.
C. Chirouse, O. M. I.
A. D. Pamburn, interpreter.
John Whitford, his x mark, interpreter.
Mathew Dofa, his x mark, interpreter.
William Craig, interpreter.
James Coxey, his x mark, interpreter.
Patrick McKenzie, interpreter.
Arch. Gracie, jr., brevet second lieutenant, Fourth Infantry.
R. R. Thompson, Indian agent.
R. B. Metcalfe, Indian sub-agent.

[Page 698]

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TREATY WITH THE NEZ PERCÉS, 1855.

June 11, 1855.

12 Stats., 957. Ratified Mar. 8, 1859. Proclaimed Apr. 29, 1859.

Articles of agreement and convention made and concluded at the treaty ground, Camp Stevens, in the Walla-Walla Valley, this eleventh day of June, in the year one thousand eight hundred and fifty-five, by and between Isaac I. Stevens, governor and superintendent of Indian affairs for the Territory of Washington, and Joel Palmer, superintendent of Indian affairs for Oregon Territory, on the part of the United States, and the undersigned chiefs, head-men, and delegates of the Nez Percé tribe of Indians occupying lands lying partly in Oregon and partly in Washington Territories, between the Cascade and Bitter Root Mountains, on behalf of, and acting for said tribe, and being duly authorized thereto by them, it being understood that Superintendent Isaac I. Stevens assumes to treat only with those of the above-named tribe of Indians residing within the Territory of Washington, and Superintendent Palmer with those residing exclusively in Oregon Territory.

Cession of lands to the United States.

ARTICLE 1. The said Nez Percé tribe of Indians hereby cede, relinquish and convey to the United States all their right, title, and interest in and to the country occupied or claimed by them, bounded and described as follows, to wit: Commencing at the source of the Wo-na-ne-she or southern tributary of the Palouse River; thence down that river to the main Palouse; thence in a southerly direction to the Snake River, at the mouth of the Tucanon River; thence up the Tucanon to its source in the Blue Mountains; thence southerly along the ridge of the Blue Mountains; thence to a point on Grand Ronde River, midway between Grand Ronde and the mouth of the Woll-low-how River; thence along the divide between the waters of the Woll-low-how and Powder River; thence to the crossing of Snake River, at the mouth of Powder River; thence to the Salmon River, fifty miles above the place known [as] the "crossing of the Salmon River;" thence due north to the summit of the Bitter Root Mountains; thence along the crest of the Bitter Root Mountains to the place of beginning.

Boundaries.

Reservation.

ARTICLE 2. There is, however, reserved from the lands above ceded for the use and occupation of the said tribe, and as a general reserva-

[Page 702]

tion for other friendly tribes and bands of Indians in Washington Territory, not to exceed the present numbers of the Spokane, Walla-Walla, Cayuse, and Umatilla tribes and bands of Indians, the tract of land included within the following boundaries, to wit: Commencing where the Moh ha-na-she or southern tributary of the Palouse River flows from the spurs of the Bitter Root Mountains; thence down said tributary to the mouth of the Ti-nat-pan-up Creek; thence southerly to the crossing of the Snake River ten miles below the mouth of the Al-po-wa-wi River; thence to the source of the Al-po-wa-wi River in the Blue Mountains; thence along the crest of the Blue Mountains; thence to the crossing of the Grand Ronde River, midway between the Grand Ronde and the mouth of the Woll-low-how River; thence along the divide between the waters of the Woll-low-how and Powder Rivers; thence to the crossing of the Snake River fifteen miles below the mouth of the Powder River; thence to the Salmon River above the crossing; thence by the spurs of the Bitter Root Mountains to the place of beginning. Boundaries.

All which tract shall be set apart, and, so far as necessary, surveyed and marked out for the exclusive use and benefit of said tribe as an Indian reservation; nor shall any white man, excepting those in the employment of the Indian Department, be permitted to reside upon the said reservation without permission of the tribe and the superintendent and agent; and the said tribe agrees to remove to and settle upon the same within one year after the ratification of this treaty. In the mean time it shall be lawful for them to reside upon any ground not in the actual claim and occupation of citizens of the United States, and upon any ground claimed or occupied, if with the permission of the owner or claimant, guarantying, however, the right to all citizens of the United States to enter upon and occupy as settlers any lands not actually occupied and cultivated by said Indians at this time, and not included in the reservation above named. And provided that any substantial improvement heretofore made by any Indian, such as fields enclosed and cultivated, and houses erected upon the lands hereby ceded, and which he may be compelled to abandon in consequence of this treaty, shall be valued under the direction of the President of the United States, and payment made therefor in money, or improvements of an equal value be made for said Indian upon the reservation, and no Indian will be required to abandon the improvements aforesaid, now occupied by him, until their value in money or improvements of equal value shall be furnished him as aforesaid. Reservation to be set apart, and Indians to settle thereon. Whites not to reside thereon without, etc. Improvements to be paid for by the United States.

ARTICLE 3. And provided that, if necessary for the public convenience, roads may be run through the said reservation, and, on the other hand, the right of way, with free access from the same to the nearest public highway, is secured to them, as also the right, in common with citizens of the United States, to travel upon all public highways. The use of the Clear Water and other streams flowing through the reservation is also secured to citizens of the United States for rafting purposes, and as public highways. Roads may be made.

The exclusive right of taking fish in all the streams where running through or bordering said reservation is further secured to said Indians; as also the right of taking fish at all usual and accustomed places in common with citizens of the Territory; and of erecting temporary buildings for curing, together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land. Privileges secured to Indians.

ARTICLE 4. In consideration of the above cession, the United States agree to pay to the said tribe in addition to the goods and provisions distributed to them at the time of signing this treaty, the sum of two hundred thousand dollars, in the following manner, that is to say, sixty thousand dollars, to be expended under the direction of the President of the United States, the first year after the ratification of this treaty, Payments by the United States.

[Page 703]

in providing for their removal to the reserve, breaking up and fencing farms, building houses, supplying them with provisions and a suitable outfit, and for such other objects as he may deem necessary, and the remainder in annuities, as follows: for the first five years after the ratification of this treaty, ten thousand dollars each year, commencing September 1, 1856; for the next five years, eight thousand dollars each year; for the next five years, six thousand each year, and for the next five years, four thousand dollars each year.

Payments, how to be applied.

All which said sums of money shall be applied to the use and benefit of the said Indians, under the direction of the President of the United States, who may from time to time determine, at his discretion, upon what beneficial objects to expend the same for them. And the superintendent of Indian affairs, or other proper officer, shall each year inform the President of the wishes of the Indians in relation thereto.

The United States to establish schools, etc.

ARTICLE 5. The United States further agree to establish, at suitable points within said reservation, within one year after the ratification hereof, two schools, erecting the necessary buildings, keeping the same in repair, and providing them with furniture, books, and stationery, one of which shall be an agricultural and industrial school, to be located at the agency, and to be free to the children of said tribe, and to employ one superintendent of teaching and two teachers; to build two blacksmiths' shops, to one of which shall be attached a tin-shop and to the other a gunsmith's shop; one carpenter's shop, one wagon and plough maker's shop, and to keep the same in repair, and furnished with the necessary tools; to employ one superintendent of farming and two farmers, two blacksmiths, one tinner, one gunsmith, one carpenter, one wagon and plough maker, for the instruction of the Indians in trades, and to assist them in the same; to erect one saw-mill and one flouring-mill, keeping the same in repair, and furnished with the necessary tools and fixtures, and to employ two millers; to erect a hospital, keeping the same in repair, and provided with the necessary medicines and furniture, and to employ a physician; and to erect, keep in repair, and provide with the necessary furniture the buildings required for the accommodation of the said employees. The said buildings and establishments to be maintained and kept in repair as aforesaid, and the employees to be kept in service for the period of twenty years.

To build mechanics' shops, etc.

Sawmill.

Hospital.

Salary to head chief; house, etc.

And in view of the fact that the head chief of the tribe is expected, and will be called upon, to perform many services of a public character, occupying much of his time, the United States further agrees to pay to the Nez Percé tribe five hundred dollars per year for the term of twenty years, after the ratification hereof, as a salary for such person as the tribe may select to be its head chief. To build for him, at a suitable point on the reservation, a comfortable house, and properly furnish the same, and to plough and fence for his use ten acres of land. The said salary to be paid to, and the said house to be occupied by, such head chief so long as he may be elected to that position by his tribe, and no longer.

And all the expenditures and expenses contemplated in this fifth article of this treaty shall be defrayed by the United States, and shall not be deducted from the annuities agreed to be paid to said tribe; nor shall the cost of transporting the goods for the annuity-payments be a charge upon the annuities, but shall be defrayed by the United States.

Reservation may be surveyed into lots and assigned to individuals or families.

ARTICLE 6. The President may from time to time, at his discretion, cause the whole, or such portions of such reservation as he may think proper, to be surveyed into lots, and assign the same to such individuals or families of the said tribe as are willing to avail themselves of the privilege, and will locate on the same as a permanent home, on

[Page 704]

the same terms and subject to the same regulations as are provided in the sixth article of the treaty with the Omahas in the year 1854, so far as the same may be applicable.

Annuities not to pay debts of individuals.

ARTICLE 7. The annuities of the aforesaid tribe shall not be taken to pay the debts of individuals.

Tribes to preserve friendly relations.

ARTICLE 8. The aforesaid tribe acknowledge their dependence upon the Government of the United States, and promise to be friendly with all citizens thereof, and pledge themselves to commit no depredations on the property of such citizens; and should any one or more of them violate this pledge, and the fact be satisfactorily proved before the agent, the property taken shall be returned, or in default thereof, or if injured or destroyed, compensation may be made by the Government out of the annuities. Nor will they make war on any other tribe except in self-defence, but will submit all matters of difference between them and the other Indians to the Government of the United States, or its agent, for decision, and abide thereby; and if any of the said Indians commit any depredations on any other Indians within the Territory of Washington, the same rule shall prevail as that prescribed in this article in cases of depredations against citizens. And the said tribe agrees not to shelter or conceal offenders against the laws of the United States, but to deliver them up to the authorities for trial.

To pay for depredations.

Not to make war except in self-defense.

Offenders to be delivered up.

Annuities may be withheld from those who drink ardent spirits.

ARTICLE 9. The Nez Percés desire to exclude from their reservation the use of ardent spirits, and to prevent their people from drinking the same; and therefore it is provided that any Indian belonging to said tribe who is guilty of bringing liquor into said reservation, or who drinks liquor, may have his or her proportion of the annuities withheld from him or her for such time as the President may determine.

Land of William Craig.

ARTICLE 10. The Nez Percé Indians having expressed in council a desire that William Craig should continue to live with them, he having uniformly shown himself their friend, it is further agreed that the tract of land now occupied by him, and described in his notice to the register and receiver of the land-office of the Territory of Washington, on the fourth day of June last, shall not be considered a part of the reservation provided for in this treaty, except that it shall be subject in common with the lands of the reservation to the operations of the intercourse act.

When treaty to take effect.

ARTICLE 11. This treaty shall be obligatory upon the contracting parties as soon as the same shall be ratified by the President and Senate of the United States.

In testimony whereof, the said Isaac I. Stevens, governor and superintendent of Indian affairs for the Territory of Washington, and Joel Palmer, superintendent of Indian affairs for Oregon Territory, and the chiefs, headmen, and delegates of the aforesaid Nez Percé tribe of Indians, have hereunto set their hands and seals, at the place, and on the day and year hereinbefore written.

ISAAC I. STEVENS, [L. S.]
Governor and Superintendent Washington Territory.
JOEL PALMER, [L. S.]
Superintendent Indian Affairs.

Aleiya, or Lawyer, Head-chief of the Nez Percés, [L. S.]
Appushwa-hite, or Looking-glass, his x mark. [L. S.]
Joseph, his x mark. [L. S.]
James, his x mark. [L. S.]
Red Wolf, his x mark. [L. S.]
Timothy, his x mark. [L. S.]
U-ute-sin-male-cun, his x mark. [L. S.]
Spotted Eage, his x mark. [L. S.]
Stoop-toop-nin or Cut-hair, his x mark. [L. S.]
Tah-moh-moh-kin, his x mark. [L. S.]
Tippelanecbupooh, his x mark. [L. S.]
Hah-hah-stilpilp, his x mark. [L. S.]
Cool-cool-shua-nin, his x mark. [L. S.]
Silish, his x mark. [L. S.]
Toh-toh-molewit, his x mark. [L. S.]
Tuky-in-lik-it, his x mark. [L. S.]
Te-hole-hole-soot, his x mark. [L. S.]
Ish-coh-tim, his x mark. [L. S.]
Wee-as-cus, his x mark. [L. S.]
Hah-hah-stoore-tee, his x mark. [L. S.]
Eee-maht-sin-pooh, his x mark. [L. S.]
Tow-wish-au-il-pilp, his x mark. [L. S.]
Kay-kay-mass, his x mark. [L. S.]

Speaking Eagle, his x mark. [L. S.]
Wat-ti-wat-ti-wah-hi, his x mark. [L. S.]
Howh-no-tah-kun, his x mark. [L. S.]
Tow-wish-wane, his x mark. [L. S.]
Wahpt-tah-shooshe, his x mark. [L. S.]
Bead Necklace, his x mark. [L. S.]
Koos-koos-tas-kut, his x mark. [L. S.]
Levi, his x mark. [L. S.]
Pee-oo-pe-whi-hi, his x mark. [L. S.]
Pee-oo-pee-iecteim, his x mark. [L. S.]
Pee-poome-kah, his x mark. [L. S.]
Hah-hah-stlil-at-me, his x mark. [L. S.]
Wee-yoke-sin-ate, his x mark. [L. S.]
Wee-ah-ki, his x mark. [L. S.]
Necalahtsin, his x mark. [L. S.]
Suck-on-tie, his x mark. [L. S.]
Ip-nat-tam-moose, his x mark. [L. S.]
Jason, his x mark. [L. S.]
Kole-kole-til-ky, his x mark. [L. S.]
In-mat-tute-kah-ky, his x mark. [L. S.]
Moh-see-chee, his x mark. [L. S.]
George, his x mark. [L. S.]
Nicke-el-it-may-ho, his x mark. [L. S.]
Say-i-ee-ouse, his x mark. [L. S.]
Wis-tasse-cut, his x mark. [L. S.]
Ky-ky-soo-te-lum, his x mark. [L. S.]
Ko-ko-whay-nee, his x mark. [L. S.]
Kwin-to-kow, his x mark. [L. S.]
Pee-wee-au-ap-tah, his x mark. [L. S.]
Wee-at-tenat-il-pilp, his x mark. [L. S.]
Pee-oo-pee-u-il-pilp, his x mark. [L. S.]
Wah-tass-tum-mannee, his x mark. [L. S.]
Tu-wee-si-ce, his x mark. [L. S.]
Lu-ee-sin-kah-koose-sin, his x mark. [L. S.]
Hah-tal-ee-kin, his x mark. [L. S.]

Signed and sealed in presence of us—

James Doty, secretary of treaties, W. T.
Wm. C. McKay, secretary of treaties, O. T.
W. H. Tappan, sub-Indian agent,
William Craig, interpreter,
A. D. Pamburn, interpreter,
Wm. McBean,
Geo. C. Bomford,
C. Chirouse, O. M. T.
Mie. Cles. Pandosy,
Lawrence Kip,
W. H. Pearson.

[Page 706]

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TREATY WITH THE FLATHEADS, ETC., 1855.

July 16, 1855.

12 Stats., 975.
Ratified Mar. 8, 1859.
Proclaimed Apr. 18, 1859.

Articles of agreement and convention made and concluded at the treaty-ground at Hell Gate, in the Bitter Root Valley, this sixteenth day of July, in the year one thousand eight hundred and fifty-five, by and between Isaac I. Stevens, governor and superintendent of Indian affairs for the Territory of Washington, on the part of the United States, and the undersigned chiefs, head-men, and delegates of the confederated tribes of the Flathead, Kootenay, and Upper Pend d'Oreilles Indians, on behalf of and acting for said confederated tribes, and being duly authorized thereto by them. It being understood and agreed that the said confederated tribes do hereby constitute a nation, under the name of the Flathead Nation, with Victor, the head chief of the Fleathead tribe, as the head chief of the said nation, and that the several chiefs, head-men, and delegates, whose names are signed to this treaty, do hereby, in behalf of their respective tribes, recognise Victor as said head chief.

Cession of lands to the United States.

ARTICLE 1. The said confederated tribe of Indians hereby cede, relinquish, and convey to the United States all their right, title, and interest in and to the country occupied or claimed by them, bounded and described as follows, to wit:

Boundaries.

Commencing on the main ridge of the Rocky Mountains at the forty-ninth (49th) parallel of latitude, thence westwardly on that parallel to the divide between the Flat-bow or Kootenay River and Clarke's Fork, thence southerly and southeasterly along said divide to the one hundred and fifteenth degree of longitude, (115°,) thence in a southwesterly direction to the divide between the sources of the St. Regis Borgia and the Cœur d'Alene Rivers, thence southeasterly and southerly along the main ridge of the Bitter Root Mountains to the divide between the head-waters of the Koos-koos-kee River and of the southwestern fork of the Bitter Root River, thence easterly along the divide separating the waters of the several tributaries of the Bitter Root River from the waters flowing into the Salmon and Snake Rivers to the main ridge of the Rocky Mountains, and thence northerly along said main ridge to the place of beginning.

Reservation.

ARTICLE 2. There is, however, reserved from the lands above ceded, for the use and occupation of the said confederated tribes, and as a general Indian reservation, upon which may be placed other friendly tribes and bands of Indians of the Territory of Washington who may agree to be consolidated with the tribes parties to this treaty, under the common designation of the Flathead Nation, with Victor, head chief of the Flathead tribe, as the head chief of the nation, the tract of land included within the following boundaries, to wit:

Boundaries.

Commencing at the source of the main branch of the Jocko River; thence along the divide separating the waters flowing into the Bitter Root River from those flowing into the Jocko to a point on Clarke's Fork between the Camash and Horse Prairies; thence northerly to, and along the divide bounding on the west the Flathead River, to a point due west from the point half way in latitude between the northern and southern extremities of the Flathead Lake; thence on a due east course to the divide whence the Crow, the Prune, the So-ni-el-em and the Jocko Rivers take their rise, and thence southerly along said divide to the place of beginning.

Whites not to reside thereon unless, etc.

All which tract shall be set apart, and, so far as necessary, surveyed and marked out for the exclusive use and benefit of said confederated tribes as an Indian reservation. Nor shall any white man, excepting those in the employment of the Indian department, be permitted to reside upon the said reservation without permission of the confederated

[Page 722]

tribes, and the superintendent and agent. And the said confederated tribes agree to remove to and settle upon the same within one year after the ratification of this treaty. In the meantime it shall be lawful for them to reside upon any ground not in the actual claim and occupation of citizens of the United States, and upon any ground claimed or occupied, if with the permission of the owner or claimant.

Guaranteeing however the right to all citizens of the United States to enter upon and occupy as settlers any lands not actually occupied and cultivated by said Indians at this time, and not included in the reservation above named. *And provided*, That any substantial improvements heretofore made by any Indian, such as fields enclosed and cultivated and houses erected upon the lands hereby ceded, and which he may be compelled to abandon in consequence of this treaty, shall be valued under the direction of the President of the United States, and payment made therefor in money, or improvements of an equal value be made for said Indian upon the reservation; and no Indian will be required to abandon the improvements aforesaid, now occupied by him, until their value in money or improvements of an equal value shall be furnished him as aforesaid.

Indians to be allowed for improvements on land ceded.

ARTICLE 3. *And provided*, That if necessary for the public convenience roads may be run through the said reservation; and, on the other hand, the right of way with free access from the same to the nearest public highway is secured to them, as also the right in common with citizens of the United States to travel upon all public highways.

Roads may be made through reservation.

The exclusive right of taking fish in all the streams running through or bordering said reservation is further secured to said Indians; as also the right of taking fish at all usual and accustomed places, in common with citizens of the Territory, and of erecting temporary buildings for curing; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land.

Rights and privileges of Indians.

ARTICLE 4. In consideration of the above cession, the United States agree to pay to the said confederated tribes of Indians, in addition to the goods and provisions distributed to them at the time of signing this treaty the sum of one hundred and twenty thousand dollars, in the following manner—that is to say: For the first year after the ratification hereof, thirty-six thousand dollars, to be expended under the direction of the President, in providing for their removal to the reservation, breaking up and fencing farms, building houses for them, and for such other objects as he may deem necessary. For the next four years, six thousand dollars each year; for the next five years, five thousand dollars each year; for the next five years, four thousand dollars each year; and for the next five years, three thousand dollars each year.

Payments by the United States.

All which said sums of money shall be applied to the use and benefit of the said Indians, under the direction of the President of the United States, who may from time to time determine, at his discretion, upon what beneficial objects to expend the same for them, and the superintendent of Indian affairs, or other proper officer, shall each year inform the President of the wishes of the Indians in relation thereto.

How to be applied.

ARTICLE 5. The United States further agree to establish at suitable points within said reservation, within one year after the ratification hereof, an agricultural and industrial school, erecting the necessary buildings, keeping the same in repair, and providing it with furniture, books, and stationery, to be located at the agency, and to be free to the children of the said tribes, and to employ a suitable instructor or instructors. To furnish one blacksmith shop, to which shall be attached a tin and gun shop; one carpenter's shop; one wagon and ploughmaker's shop; and to keep the same in repair, and furnished with the

United States to establish schools.

Mechanics' shop.

[Page 723]

necessary tools. To employ two farmers, one blacksmith, one tinner, one gunsmith, one carpenter, one wagon and plough maker, for the instruction of the Indians in trades, and to assist them in the same. To erect one saw-mill and one flouring-mill, keeping the same in repair and furnished with the necessary tools and fixtures, and to employ two millers. To erect a hospital, keeping the same in repair, and provided with the necessary medicines and furniture, and to employ a physician; and to erect, keep in repair, and provide the necessary furniture the buildings required for the accommodation of said employees. The said buildings and establishments to be maintained and kept in repair as aforesaid, and the employees to be kept in service for the period of twenty years.

Hospital.

To pay salary to head chiefs.

And in view of the fact that the head chiefs of the said confederated tribes of Indians are expected and will be called upon to perform many services of a public character, occupying much of their time, the United States further agree to pay to each of the Flathead, Kootenay, and Upper Pend d'Oreilles tribes five hundred dollars per year, for the term of twenty years after the ratification hereof, as a salary for such persons as the said confederated tribes may select to be their head chiefs, and to build for them at suitable points on the reservation a comfortable house, and properly furnish the same, and to plough and fence for each of them ten acres of land. The salary to be paid to, and the said houses to be occupied by, such head chiefs so long as they may be elected to that position by their tribes, and no longer.

Certain expenses to be borne by the United States and not charged on annuities.

And all the expenditures and expenses contemplated in this article of this treaty shall be defrayed by the United States, and shall not be deducted from the annuities agreed to be paid to said tribes. Nor shall the cost of transporting the goods for the annuity payments be a charge upon the annuities, but shall be defrayed by the United States.

Lots may be assigned to individuals.

ARTICLE 6. The President may from time to time, at his discretion, cause the whole, or such portion of such reservation as he may think proper, to be surveyed into lots, and assign the same to such individuals or families of the said confederated tribes as are willing to avail themselves of the privilege, and will locate on the same as a permanent home, on the same terms and subject to the same regulations as are provided in the sixth article of the treaty with the Omahas, so far as the same may be applicable.

Ante, p. 612.

Annuities not to pay individuals' debts.

ARTICLE 7. The annuities of the aforesaid confederated tribes of Indians shall not be taken to pay the debts of individuals.

Indians to preserve friendly relations.

Indians to pay for depredations, not to make war except, etc.

ARTICLE 8. The aforesaid confederated tribes of Indians acknowledge their dependence upon the Government of the United States, and promise to be friendly with all citizens thereof, and pledge themselves to commit no depredations upon the property of such citizens. And should any one or more of them violate this pledge, and the fact be satisfactorily proved before the agent, the property taken shall be returned, or, in default thereof, or if injured or destroyed, compensation may be made by the Government out of the annuities. Nor will they make war on any other tribe except in self-defence, but will submit all matters of difference between them and other Indians to the Government of the United States, or its agent, for decision, and abide thereby. And if any of the said Indians commit any depredations on any other Indians within the jurisdiction of the United States, the same rule shall prevail as that prescribed in this article, in case of depredations against citizens. And the said tribes agree not to shelter or conceal offenders against the laws of the United States, but to deliver them up to the authorities for trial.

To surrender offenders.

Annuities to be reserved from those who drink, etc., ardent spirits.

ARTICLE 9. The said confederated tribes desire to exclude from their reservation the use of ardent spirits, and to prevent their people from drinking the same; and therefore it is provided that any Indian belonging to said confederated tribes of Indians who is guilty of bringing

[Page 724]

liquor into said reservation, or who drinks liquor, may have his or her proportion of the annuities withheld from him or her for such time as the President may determine.

ARTICLE 10. The United States further agree to guaranty the exclusive use of the reservation provided for in this treaty, as against any claims which may be urged by the Hudson Bay Company under the provisions of the treaty between the United States and Great Britain of the fifteenth of June, eighteen hundred and forty-six, in consequence of the occupation of a trading-post on the Pru-in River by the servants of that company.

Guaranty of reservation against certain claims of Hudson Bay Company.

ARTICLE 11. It is, moreover, provided that the Bitter Root Valley, above the Loo-lo Fork, shall be carefully surveyed and examined, and if it shall prove, in the judgment of the President, to be better adapted to the wants of the Flathead tribe than the general reservation provided for in this treaty, then such portions of it as may be necessary shall be set apart as a separate reservation for the said tribe. No portion of the Bitter Root Valley, above the Loo-lo Fork, shall be opened to settlement until such examination is had and the decision of the President made known.

Bitter Root Valley to be surveyed, and portions may be set apart for reservation.

Meanwhile not to be opened for settlement.

ARTICLE 12. This treaty shall be obligatory upon the contracting parties as soon as the same shall be ratified by the President and Senate of the United States.

When treaty to take effect.

In testimony whereof, the said Isaac I. Stevens, governor and superintendent of Indian affairs for the Territory of Washington, and the undersigned head chiefs, chiefs and principal men of the Flathead, Kootenay, and Upper Pend d'Oreilles tribes of Indians, have hereunto set their hands and seals, at the place and on the day and year hereinbefore written.

Isaac I. Stevens, [L. S.]
Governor and Superintendent Indian Affairs W. T.

Victor, head chief of the Flathead Nation, his x mark.	[L. S.]	Big Canoe, his x mark.	[L. S.]
Alexander, chief of the Upper Pend d'Oreilles, his x mark.	[L. S.]	Kootel Chah, his x mark.	[L. S.]
Michelle, chief of the Kootenays, his x mark.	[L. S.]	Paul, his x mark.	[L. S.]
Ambrose, his x mark.	[L. S.]	Andrew, his x mark.	[L. S.]
Pah-soh, his x mark.	[L. S.]	Michelle, his x mark.	[L. S.]
Bear Track, his x mark.	[L. S.]	Battiste, his x mark.	[L. S.]
Adolphe, his x mark.	[L. S.]	*Kootenays.*	
Thunder, his x mark.	[L. S.]	Gun Flint, his x mark.	[L. S.]
		Little Michelle, his x mark.	[L. S.]
		Paul See, his x mark.	[L. S.]
		Moses, his x mark.	[L. S.]

James Doty, secretary.
R. H. Lansdale, Indian Agent.
W. H. Tappan, sub Indian Agent.
Henry R. Crosire,
Gustavus Sohon, Flathead Interpreter.
A. J. Hoecken, sp. mis.
William Craig.

[Page 725]

TREATY WITH THE TRIBES OF MIDDLE OREGON, 1855.

June 25, 1855.

12 Stats., 963.
Ratified Mar. 8, 1859.
Proclaimed Apr. 18, 1859.

Articles of agreement and convention made and concluded at Wasco, near the Dalles of the Columbia River, in Oregon Territory, by Joel Palmer, superintendent of Indian affairs, on the part of the United States, and the following-named chiefs and head-men of the confederated tribes and bands of Indians, residing in Middle Oregon, they being duly authorized thereto by their respective bands, to wit: Symtustus, Locks-quis-sa, Shick-a-me, and Kuck-up, chiefs of the Taih or Upper De Chutes band of Walla-Wallas; Stocket-ly and Iso, chiefs of the Wyam or Lower De Chutes band of Walla-Wallas; Alexis and Talkish, chiefs of the Tenino band of Walla-Wallas; Yise, chief of the Dock-Spus or John Day's River band of Walla-Wallas; Mark, William Chenook, and Cush-Kella, chiefs of the Dalles band of the Wascoes; Toh-simph, chief of the Ki-gal-twal-la band of Wascoes; and Wal-la-chin, chief of the Dog River band of Wascoes.

Cession of lands to the United States.

ARTICLE 1. The above-named confederated bands of Indians cede to the United States all their right, title, and claim to all and every part of the country claimed by them, included in the following boundaries, to wit:

Boundaries.

Commencing in the middle of the Columbia River, at the Cascade Falls, and running thence southerly to the summit of the Cascade Mountains; thence along said summit to the forty-fourth parallel of north latitude; thence east on that parallel to the summit of the Blue Mountains, or the western boundary of the Sho-sho-ne or Snake country; thence northerly along that summit to a point due east from the head-waters of Willow Creek; thence west to the head-waters of said creek; thence down said stream to its junction with the Columbia River; and thence down the channel of the Columbia River to the place of beginning. *Provided, however*, that so much of the country described above as is contained in the following boundaries, shall, until otherwise directed by the President of the United States, be set apart as a residence for said Indians, which tract for the purposes contemplated shall be held and regarded as an Indian reservation, to wit:

Reservation.

Boundaries.

Commencing in the middle of the channel of the De Chutes River opposite the eastern termination of a range of high lands usually known as the Mutton Mountains; thence westerly to the summit of said range, along the divide to its connection with the Cascade Mountains;

[Page 714]

thence to the summit of said mountains; thence southerly to Mount Jefferson; thence down the main branch of De Chutes River; heading in this peak, to its junction with De Chutes River; and thence down the middle of the channel of said river to the place of beginning. All of which tract shall be set apart, and, so far as necessary, surveyed and marked out for their exclusive use; nor shall any white person be permitted to reside upon the same without the concurrent permission of the agent and superintendent.

Whites not to reside thereon unless, etc.

The said bands and tribes agree to remove to and settle upon the same within one year after the ratification of this treaty, without any additional expense to the United States other than is provided for by this treaty; and, until the expiration of the time specified, the said bands shall be permitted to occupy and reside upon the tracts now possessed by them, guaranteeing to all white citizens the right to enter upon and occupy as settlers any lands not included in said reservation, and not actually inclosed by said Indians. *Provided, however*, That prior to the removal of said Indians to said reservation, and before any improvements contemplated by this treaty shall have been commenced, that if the three principal bands, to wit: the Wascopum, Tiah, or Upper De Chutes, and the Lower De Chutes bands of Walla-Wallas shall express in council, a desire that some other reservation may be selected for them, that the three bands named may select each three persons of their respective bands, who with the superintendent of Indian affairs or agent, as may by him be directed, shall proceed to examine, and if another location can be selected, better suited to the condition and wants of said Indians, that is unoccupied by the whites, and upon which the board of commissioners thus selected may agree, the same shall be declared a reservation for said Indians, instead of the tract named in this treaty. *Provided, also*, That the exclusive right of taking fish in the streams running through and bordering said reservation is hereby secured to said Indians; and at all other usual and accustomed stations, in common with citizens of the United States, and of erecting suitable houses for curing the same; also the privilege of hunting, gathering roots and berries, and pasturing their stock on unclaimed lands, in common with citizens, is secured to them. *And provided, also*, That if any band or bands of Indians, residing in and claiming any portion or portions of the country in this article, shall not accede to the terms of this treaty, then the bands becoming parties hereunto agree to receive such part of the several and other payments herein named as a consideration for the entire country described as aforesaid as shall be in the proportion that their aggregate number may have to the whole number of Indians residing in and claiming the entire country aforesaid, as consideration and payment in full for the tracts in said country claimed by them. *And provided, also*, That where substantial improvements have been made by any members of the bands being parties to this treaty, who are compelled to abandon them in consequence of said treaty, the same shall be valued, under the direction of the President of the United States, and payment made therefor; or, in lieu of said payment, improvements of equal extent and value at their option shall be made for them on the tracts assigned to each respectively.

Bands to settle thereon within a year.

Another reservation to be selected in lieu of this, if, etc.

Rights and privileges secured to Indians.

See Art. 1, treaty of Nov. 1, 1865.

Proviso in case any band does not accede to this treaty.

Allowance for improvements if, etc.

ARTICLE 2. In consideration of, and payment for, the country hereby ceded, the United States agree to pay the bands and tribes of Indians claiming territory and residing in said country, the several sums of money following, to wit:

Payments by the United States.

Eight thousand dollars per annum for the first five years, commencing on the first day of September, 1856, or as soon thereafter as practicable.

Six thousand dollars per annum for the term of five years next succeeding the first five.

[Page 715]

Four thousand dollars per annum for the term of five years next succeeding the second five; and

Two thousand dollars per annum for the term of five years next succeeding the third five.

How to be expended.

All of which several sums of money shall be expended for the use and benefit of the confederated bands, under the direction of the President of the United States, who may from time to time, at his discretion determine what proportion thereof shall be expended for such objects as in his judgment will promote their well-being and advance them in civilization; for their moral improvement and education; for building, opening and fencing farms, breaking land, providing teams, stock, agricultural implements, seeds, &c.; for clothing, provisions, and tools; for medical purposes, providing mechanics and farmers, and for arms and ammunition.

$50,000 additional to be expended for buildings, etc.

ARTICLE 3. The United States agree to pay said Indians the additional sum of fifty thousand dollars, a portion whereof shall be applied to the payment for such articles as may be advanced them at the time of signing this treaty, and in providing, after the ratification thereof and prior to their removal, such articles as may be deemed by the President essential to their want; for the erection of buildings on the reservation, fencing and opening farms; for the purchase of teams, farming implements, clothing and provisions, tools, seeds, and for the payment of employees; and for subsisting the Indians the first year after their removal.

United States to erect sawmills, school-house, etc.

ARTICLE 4. In addition to the considerations specified the United States agree to erect, at suitable points on the reservation, one saw-mill and one flouring-mill; suitable hospital buildings; one school-house; one blacksmith-shop with a tin and a gunsmith-shop thereto attached; one wagon and ploughmaker shop; and for one sawyer, one miller, one superintendent of farming operations, a farmer, a physician, a school-teacher, a blacksmith, and a wagon and ploughmaker, a dwelling house and the requisite outbuildings for each; and to purchase and keep in repair for the time specified for furnishing employees all necessary mill-fixtures, mechanics' tools, medicines and hospital stores, books and stationery for schools, and furniture for employees.

To furnish farmer, mechanics, physician, etc.

The United States further engage to secure and pay for the services and subsistence, for the term of fifteen years, of one farmer, one blacksmith, and one wagon and plough maker; and for the term of twenty years, of one physician, one sawyer, one miller, one superintendent of farming operations, and one school teacher.

To erect dwelling houses, etc., for head chiefs.

The United States also engage to erect four dwelling-houses, one for the head chief of the confederated bands, and one each for the Upper and Lower De Chutes bands of Walla-Wallas, and for the Wascopum band of Wascoes, and to fence and plough for each of the said chiefs ten acres of land; also to pay the head chief of the confederated bands a salary of five hundred dollars per annum for twenty years, commencing six months after the three principal bands named in this treaty shall have removed to the reservation, or as soon thereafter as a head chief should be elected: *And provided, also,* That at any time when by the death, resignation, or removal of the chief selected, there shall be a vacancy and a successor appointed or selected, the salary, the dwelling, and improvements shall be possessed by said successor, so long as he shall occupy the position as head chief; so also with reference to the dwellings and improvements provided for by this treaty for the head chiefs of the three principal bands named.

Successor of head chief to take them.

Lands may be allotted to individual Indians for permanent homes.

ARTICLE 5. The President may, from time to time, at his discretion, cause the whole, or such portion as he may think proper, of the tract that may now or hereafter be set apart as a permanent home for these Indians, to be surveyed into lots and assigned to such Indians of the confederated bands as may wish to enjoy the privilege, and locate

[Page 716]

thereon permanently. To a single person over twenty-one years of age, forty acres; to a family of two persons, sixty acres; to a family of three and not exceeding five, eighty acres; to a family of six persons, and not exceeding ten, one hundred and twenty acres; and to each family over ten in number, twenty acres for each additional three members. And the President may provide such rules and regulations as will secure to the family in case of the death of the head thereof the possession and enjoyment of such permanent home and the improvement thereon; and he may, at any time, at his discretion, after such person or family has made location on the land assigned as a permanent home, issue a patent to such person or family for such assigned land, conditioned that the tract shall not be aliened or leased for a longer term than two years and shall be exempt from levy, sale, or forfeiture, which condition shall continue in force until a State constitution embracing such lands within its limits shall have been formed, and the legislature of the State shall remove the restrictions. *Provided, however*, That no State legislature shall remove the restrictions herein provided for without the consent of Congress. *And provided, also*, That if any person or family shall at any time neglect or refuse to occupy or till a portion of the land assigned and on which they have located, or shall roam from place to place indicating a desire to abandon his home, the President may, if the patent shall have been issued, revoke the same, and if not issued, cancel the assignment, and may also withhold from such person, or family, their portion of the annuities, or other money due them, until they shall have returned to such permanent home and resumed the pursuits of industry, and in default of their return the tract may be declared abandoned, and thereafter assigned to some other person or family of Indians residing on said reservation.

Patents to issue therefor; conditions thereof.

Restrictions not to be removed without, etc.

Patent may be cancelled.

ARTICLE 6. The annuities of the Indians shall not be taken to pay the debts of individuals.

Annuities of Indians not to pay debt of individuals.

ARTICLE 7. The confederated bands acknowledge their dependence on the Government of the United States, and promise to be friendly with all the citizens thereof, and pledge themselves to commit no depredation on the property of said citizens; and should any one or more of the Indians violate this pledge, and the fact be satisfactorily proven before the agent, the property taken shall be returned, or in default thereof, or if injured or destroyed, compensation may be made by the Government out of their annuities; nor will they make war on any other tribe of Indians except in self-defence, but submit all matters of difference between them and other Indians to the Government of the United States, or its agents for decision, and abide thereby; and if any of the said Indians commit any depredations on other Indians, the same rule shall prevail as that prescribed in the case of depredations against citizens; said Indians further engage to submit to and observe all laws, rules, and regulations which may be prescribed by the United States for the government of said Indians.

Bands to preserve friendly relations.

To pay for depredations.

Not to make war, except, etc.

ARTICLE 8. In order to prevent the evils of intemperance among said Indians, it is hereby provided, that if any one of them shall drink liquor to excess, or procure it for others to drink, his or her proportion of the annuities may be withheld from him or her for such time as the President may determine.

Annuities to be withheld from those drinking liquor to excess.

ARTICLE 9. The said confederated bands agree that whensoever, in the opinion of the President of the United States, the public interest may require it, that all roads, highways, and railroads shall have the right of way through the reservation herein designated, or which may at any time hereafter be set apart as a reservation for said Indians.

Roads, etc., may be made through reservation.

This treaty shall be obligatory on the contracting parties as soon as the same shall be ratified by the President and Senate of the United States.

When treaty to take effect.

[Page 717]

In testimony whereof, the said Joel Palmer, on the part of the United States, and the undersigned, chiefs, headmen, and delegates of the said confederated bands, have hereunto set their hands and seals, this twenty-fifth day of June, eighteen hundred fifty-five.

Joel Palmer, Superintendent of Indian Affairs, O. T. [L. S.]

Wasco:
Mark, his x mark. [L. S.]
William Chenook, his x mark. [L. S.]
Cush Kella, his x mark. [L. S.]
Lower De Chutes:
Stock-etley, his x mark. [L. S.]
Iso, his x mark. [L. S.]
Upper De Chutes:
Simtustus, his x mark. [L. S.]
Locksquissa, his x mark. [L. S.]
Shick-ame, his x mark. [L. S.]
Kuck-up, his x mark. [L. S.]
Tenino:
Alexsee, his x mark. [L. S.]
Talekish, his x mark. [L. S.]
Dog River Wasco:
Walachin, his x mark. [L. S.]
Tah Symph, his x mark. [L. S.]
Ash-na-chat, his x mark. [L. S.]
Che-wot-nleth, his x mark. [L. S.]
Te-cho, his x mark. [L. S.]
Sha-qually, his x mark. [L. S.]
Louis, his x mark. [L. S.]
Yise, his x mark. [L. S.]
Stamite, his x mark. [L. S.]
Ta-cho, his x mark. [L. S.]
Penop-teyot, his x mark. [L. S.]
Elosh-kish-kie, his x mark. [L. S.]
Am. Zelic, his x mark. [L. S.]
Ke-chac, his x mark. [L. S.]
Tanes Salmon, his x mark. [L. S.]
Ta-koe, his x mark. [L. S.]
David, his x mark. [L. S.]
Sowal-we, his x mark. [L. S.]
Postie, his x mark. [L. S.]
Yawan-shewit, his x mark. [L. S.]
Own-aps, his x mark. [L. S.]
Kossa, his x mark. [L. S.]
Pa-wash-ti-mane, his x mark. [L. S.]
Ma-we-nit, his x mark. [L. S.]
Tipso, his x mark. [L. S.]
Jim, his x mark. [L. S.]
Peter, his x mark. [L. S.]
Na-yoct, his x mark. [L. S.]
Wal-tacom, his x mark. [L. S.]
Cho-kalth, his x mark. [L. S.]
Pal-sta, his x mark. [L. S.]
Mission John, his x mark. [L. S.]
Le Ka-ya, his x mark. [L. S.]
La-wit-chin, his x mark. [L. S.]
Low-las, his x mark. [L. S.]
Thomson, his x mark. [L. S.]
Charley, his x mark. [L. S.]
Copefornia, his x mark. [L. S.]
Wa-toi-mettla, his x mark. [L. S.]
Ke-la, his x mark. [L. S.]
Pa-ow-ne, his x mark. [L. S.]
Kuck-up, his x mark. [L. S.]
Poyet, his x mark. [L. S.]
Ya-wa-clax, his x mark. [L. S.]
Tam-cha-wit, his x mark. [L. S.]
Tam-mo-yo-cam, his x mark. [L. S.]
Was-ca-can, his x mark. [L. S.]
Talle Kish, his x mark. [L. S.]
Waleme Toach, his x mark. [L. S.]
Site-we-loch, his x mark. [L. S.]
Ma-ni-nect, his x mark. [L. S.]
Pich-kan, his x mark. [L. S.]
Pouh-que, his x mark. [L. S.]
Eye-eya, his x mark. [L. S.]
Kam-kus, his x mark. [L. S.]
Sim-yo, his x mark. [L. S.]
Kas-la-chin, his x mark. [L. S.]
Pio-sho-she, his x mark. [L. S.]
Mop-pa-man, his x mark. [L. S.]
Sho-es, his x mark. [L. S.]
Ta-mo-lits, his x mark. [L. S.]
Ka-lim, his x mark. [L. S.]
Ta-yes, his x mark. [L. S.]
Was-en-was, his x mark. [L. S.]
E-yath Kloppy, his x mark. [L. S.]
Paddy, his x mark. [L. S.]
Sto-quin, his x mark. [L. S.]
Charley-man, his x mark. [L. S.]
Ile-cho, his x mark. [L. S.]
Pate-cham, his x mark. [L. S.]
Yan-che-woc, his x mark. [L. S.]
Ya-toch-la-le, his x mark. [L. S.]
Alpy, his x mark. [L. S.]
Pich, his x mark. [L. S.]
William, his x mark. [L. S.]
Peter, his x mark. [L. S.]
Ischa Ya, his x mark. [L. S.]
George, his x mark. [L. S.]
Jim, his x mark. [L. S.]
Se-ya-las-ka, his x mark. [L. S.]
Ha-lai-kola, his x mark. [L. S.]
Pierro, his x mark. [L. S.]
Ash-lo-wash, his x mark. [L. S.]
Paya-tilch, his x mark. [L. S.]
Sae-pa-waltcha, his x mark. [L. S.]
Shalquilkey, his x mark. [L. S.]
Wa-qual-lol, his x mark. [L. S.]
Sim-kui-kui, his x mark. [L. S.]
Wacha-chiley, his x mark. [L. S.]
Chi-kal-kin, his x mark. [L. S.]
Squa-yash, his x mark. [L. S.]
Sha Ka, his x mark. [L. S.]
Keaui-sene, his x mark. [L. S.]
Che-chis, his x mark. [L. S.]
Sche-noway, his x mark. [L. S.]
Scho-ley, his x mark. [L. S.]
We-ya-thley, his x mark. [L. S.]
Pa-leyathley, his x mark. [L. S.]
Keyath, his x mark. [L. S.]
I-poth-pal, his x mark. [L. S.]
S. Kolps, his x mark. [L. S.]
Walimtalin, his x mark. [L. S.]
Tash Wick, his x mark. [L. S.]
Hawatch-can, his x mark. [L. S.]
Ta-wait-cla, his x mark. [L. S.]
Patoch Snort, his x mark. [L. S.]
Tachins, his x mark. [L. S.]
Comochal, his x mark. [L. S.]
Passayei, his x mark. [L. S.]
Watan-cha, his x mark. [L. S.]
Ta-wash, his x mark. [L. S.]
A-nouth-shot, his x mark. [L. S.]
Hanwake, his x mark. [L. S.]
Pata-la-set, his x mark. [L. S.]
Tash-weict, his x mark. [L. S.]
Wescha-matolla, his x mark. [L. S.]
Chle-mochle-mo, his x mark. [L. S.]
Quae-tus, his x mark. [L. S.]
Skuilts, his x mark. [L. S.]
Panospam, his x mark. [L. S.]

[Page 718]

Stolameta, his x mark.	[L. S.]	Ash-ka-wish, his x mark.	[L. S.]
Tamayechotote, his x mark.	[L. S.]	Pasquai, his x mark.	[L. S.]
Qua-losh-kin, his x mark.	[L. S.]	Wasso-kui, his x mark.	[L. S.]
Wiska Ka, his x mark.	[L. S.]	Quaino-sath, his x mark.	[L. S.]
Che-lo-tha, his x mark.	[L. S.]	Cha-ya-tema, his x mark.	[L. S.]
Wetone-yath, his x mark.	[L. S.]	Wa-ya-lo-chol-wit, his x mark.	[L. S.]
We-ya-lo-cho-wit, his x mark.	[L. S.]	Flitch Kui Kui, his x mark.	[L. S.]
Yoka-nolth, his x mark.	[L. S.]	Walcha Kas, his x mark.	[L. S.]
Wacha-ka-polle, his x mark.	[L. S.]	Watch-tla, his x mark.	[L. S.]
Kon-ne, his x mark.	[L. S.]	Enias, his x mark.	[L. S.]

Signed in presence of—

Wm. C. McKay, secretary of treaty, O. T.
R. R. Thompson, Indian agent.
R. B. Metcalfe, Indian sub-agent.
C. Mespotie.
John Flett, interpreter.
Dominick Jondron, his x mark, interpreter.
Mathew Dofa, his x mark, interpreter.

[Page 719]

TREATY WITH THE NEZ PERCÉS, 1863.

June 9, 1863.

14 Stats., 647. Ratified Apr. 17, 1867. Proclaimed Apr. 20, 1867.

Articles of agreement made and concluded at the council-ground, in the valley of the Lapwai, W. T., on the ninth day of June, one thousand eight hundred and sixty-three, between the United States of America, by C. H. Hale, superintendent of Indian affairs, and Charles Hutchins and S. D. Howe, U. S. Indian agents for the Territory of Washington, acting on the part and in behalf of the United States, and the Nez Percé Indians, by the chiefs, head-men, and delegates of said tribe, such articles being supplementary and amendatory to the treaty made between the United States and said tribe on the 11th day of June, 1855.

Cession of lands to the United States.

ARTICLE 1. The said Nez Percé tribe agree to relinquish, and do hereby relinquish, to the United States the lands heretofore reserved for the use and occupation of the said tribe, saving and excepting so much thereof as is described in Article II for a new reservation.

Reservation.

Boundaries.

ARTICLE 2. The United States agree to reserve for a home, and for the sole use and occupation of said tribe, the tract of land included within the following boundaries, to wit: Commencing at the northeast corner of Lake Wa-ha, and running thence, northerly, to a point on the north bank of the Clearwater River, three miles below the mouth of the Lapwai, thence down the north bank of the Clearwater to the mouth of the Hatwai Creek; thence, due north, to a point seven miles distant; thence, eastwardly, to a point on the north fork of the Clearwater, seven miles distant from its mouth; thence to a point on Oro Fino Creek, five miles above its mouth; thence to a point on the north fork of the south fork of the Clearwater, five miles above its mouth; thence to a point on the south fork of the Clearwater, one mile above the bridge, on the road leading to Elk City, (so as to include all the Indian farms now within the forks;) thence in a straight line, westwardly, to the place of beginning.

Reservation to be for the sole use of the tribe, who shall settle thereon within a year.

All of which tract shall be set apart, and the above-described boundaries shall be surveyed and marked out for the exclusive use and benefit of said tribe as an Indian reservation, nor shall any white man, excepting those in the employment of the Indian Department, be permitted to reside upon the said reservation without permission of the tribe and the superintendent and agent; and the said tribe agrees that so soon after the United States shall make the necessary provision for fulfilling the stipulations of this instrument as they can conveniently arrange their affairs, and not to exceed one year from its ratification, they will vacate the country hereby relinquished, and remove to and settle upon the lands herein reserved for them, (except as may be hereinafter provided.) In the meantime it shall be lawful for them to reside upon any ground now occupied or under cultivation by said Indians at this time, and not included in the reservation above named. And it is provided, that any substantial improvement heretofore made by any Indian, such as fields inclosed and cultivated, or houses erected upon the lands hereby relinquished, and which he may be compelled to abandon in consequence of this treaty, shall be valued under the direction of the President of the United States, and payment therefor shall be made in stock or in improvements of an equal value for said Indian upon the lot which may be assigned to him within the bounds of the reservation, as he may choose, and no Indian will be required to abandon the improvements aforesaid, now occupied by him, until said payment or improvement shall have been made. And it is further provided, that if any Indian living on any of the land hereby relinquished should prefer to sell his improvements to any white man, being a loyal citizen of the United States, prior to the same being valued as aforesaid, he shall be allowed so to do, but the sale or transfer of said improvements shall be made in the presence of, and with the consent

Improvements on lands ceded to be paid for.

May be sold to loyal whites.

and approval of, the agent or superintendent, by whom a certificate of sale shall be issued to the party purchasing, which shall set forth the amount of the consideration in kind. Before the issue of said certificate, the agent or superintendent shall be satisfied that a valuable consideration is paid, and that the party purchasing is of undoubted loyalty to the United States Government. No settlement or claim made upon the improved lands by any Indian will be permitted, except as herein provided, prior to the time specified for their removal. Any sale or transfer thus made shall be in the stead of payment for improvements from the United States.

Certificates of sale.

Boundary lines to be marked and lands surveyed into lots.

ARTICLE 3. The President shall, immediately after the ratification of this treaty, cause the boundary-lines to be surveyed, and properly marked and established; after which, so much of the lands hereby reserved as may be suitable for cultivation shall be surveyed into lots of twenty acres each, and every male person of the tribe who shall have attained the age of twenty-one years, or is the head of a family, shall have the privilege of locating upon one lot as a permanent home for such person, and the lands so surveyed shall be allotted under such rules and regulations as the President shall prescribe, having such reference to their settlement as may secure adjoining each other the location of the different families pertaining to each band, so far as the same may be practicable. Such rules and regulations shall be prescribed by the President, or under his direction, as will insure to the family, in case of the death of the head thereof, the possession and enjoyment of such permanent home, and the improvements thereon. When the assignments as above shall have been completed, certificates shall be issued by the Commissioner of Indian Affairs, or under his direction, for the tracts assigned in severalty, specifying the names of the individuals to whom they have been assigned respectively, and that said tracts are set apart for the perpetual and exclusive use and benefit of such assignees and their heirs. Until otherwise provided by law, such tracts shall be exempt from levy, taxation, or sale, and shall be alienable in fee, or leased, or otherwise disposed of, only to the United States, or to persons then being members of the Nez Percé tribe, and of Indian blood, with the permission of the President, and under such regulations as the Secretary of the Interior or the Commissioner of Indian Affairs shall prescribe; and if any such person or family shall at any time neglect or refuse to occupy and till a portion of the land so assigned, and on which they have located, or shall rove from place to place, the President may cancel the assignment, and may also withhold from such person or family their proportion of the annuities or other payments due them until they shall have returned to such permanent home, and resumed the pursuits of industry; and in default of their return, the tract may be declared abandoned, and thereafter assigned to some other person or family of such tribe. The residue of the land hereby reserved shall be held in common for pasturage for the sole use and benefit of the Indians: *Provided, however*, That from time to time, as members of the tribe may come upon the reservation, or may become of proper age, after the expiration of the time of one year after the ratification of this treaty, as aforesaid, and claim the privileges granted under this article, lots may be assigned from the lands thus held in common, wherever the same may be suitable for cultivation. No State or territorial legislature shall remove the restriction herein provided for, without the consent of Congress, and no State or territorial law to that end shall be deemed valid until the same has been specially submitted to Congress for its approval.

Heads of families may locate on lot.

Certificates therefor.

These lots to be exempt from levy, taxes, etc.

Residue to be held in common.

Restriction not to be removed without the consent of Congress.

Payments to the tribe.

ARTICLE 4. In consideration of the relinquishment herein made the United States agree to pay to the said tribe, in addition to the annuities provided by the treaty of June 11, 1855, and the goods and provisions distributed to them at the time of signing this treaty, the

[Page 844]

sum of two hundred and sixty-two thousand and five hundred dollars, in manner following, to wit:

First. One hundred and fifty thousand dollars, to enable the Indians to remove and locate upon the reservation, to be expended in the ploughing of land, and the fencing of the several lots, which may be assigned to those individual members of the tribe who will accept the same in accordance with the provisions of the preceding article, which said sum shall be divided into four annual instalments, as follows: For the first year after the ratification of this treaty, seventy thousand dollars; for the second year, forty thousand dollars; for the third year, twenty-five thousand dollars; for the fourth year, fifteen thousand dollars.

Second. Fifty thousand dollars to be paid the first year after the ratification of this treaty in agricultural implements, to include wagons or carts, harness, and cattle, sheep, or other stock, as may be deemed most beneficial by the superintendent of Indian affairs, or agent, after ascertaining the wishes of the Indians in relation thereto.

Third. Ten thousand dollars for the erection of a saw and flouring mill, to be located at Kamia, the same to be erected within one year after the ratification hereof.

Fourth. Fifty thousand dollars for the boarding and clothing of the children who shall attend the schools, in accordance with such rules or regulations as the Commissioner of Indian Affairs may prescribe, providing the schools and boarding-houses with necessary furniture, the purchase of necessary wagons, teams, agricultural implements, tools, &c., for their use, and for the fencing of such lands as may be needed for gardening and farming purposes, for the use and benefit of the schools, to be expended as follows: The first year after the ratification of this treaty, six thousand dollars; for the next fourteen years, three thousand dollars each year; and for the succeeding year, being the sixteenth and last instalment, two thousand dollars.

Churches.

Fifth. A further sum of two thousand five hundred dollars shall be paid within one year after the ratification hereof, to enable the Indians to build two churches, one of which is to be located at some suitable point on the Kamia, and the other on the Lapwai.

Subordinate chiefs

ARTICLE 5. The United States further agree, that in addition to a head chief the tribe shall elect two subordinate chiefs, who shall assist him in the performance of his public services, and each subordinate chief shall have the same amount of land ploughed and fenced, with comfortable house and necessary furniture, and to whom the same salary shall be paid as is already provided for the head chief in article 5 of the treaty of June 11, 1855, the salary to be paid and the houses and land to be occupied during the same period and under like restrictions as therein mentioned.

And for the purpose of enabling the agent to erect said buildings, and to plough and fence the land, as well as to procure the necessary furniture, and to complete and furnish the house, &c., of the head chief, as heretofore provided, there shall be appropriated, to be expended within the first year after the ratification hereof, the sum of two thousand five hundred dollars.

Further appropriation.

And inasmuch as several of the provisions of said art. 5th of the treaty of June 11, 1855, pertaining to the erection of school-houses, hospital, shops, necessary buildings for employe[e]s and for the agency, as well as providing the same with necessary furniture, tools, &c., have not yet been complied with, it is hereby stipulated that there shall be appropriated, to be expended for the purposes herein specified during the first year after the ratification hereof, the following sums, to wit:

Schools.

First. Ten thousand dollars for the erection of the two schools, including boarding-houses and the necessary out-buildings; said schools to be conducted on the manual-labor system as far as practicable.

Hospital.

Second. Twelve hundred dollars for the erection of the hospital, and providing the necessary furniture for the same.

Blacksmith's shop, tools, etc.

Third. Two thousand dollars for the erection of a blacksmith's shop, to be located at Kamia, to aid in the completion of the smith's shop at the agency, and to purchase the necessary tools, iron, steel, &c.; and to keep the same in repair and properly stocked with necessary tools and materials, there shall be appropriated thereafter, for the fifteen years next succeeding, the sum of five hundred dollars each year.

Houses, mills, etc.

Fourth. Three thousand dollars for erection of houses for employe[e]s, repairs of mills, shops, &c., and providing necessary furniture, tools, and materials. For the same purpose, and to procure from year to year the necessary articles—that is to say, saw-logs, nails, glass, hardwaıe, &c.—there snall be appropriated thereafter, for the twelve years next succeeding, the sum of two thousand dollars each year; and for the next three years, one thousand dollars each year.

Matrons, teachers, mechanics, millers.

And it is further agreed that the United States shall employ, in addition to those already mentioned in art. 5th of the treaty of June 11, 1855, two matrons to take charge of the boarding-schools, two assistant teachers, one farmer, one carpenter, and two millers.

All the expenditures and expenses contemplated in this treaty, and not otherwise provided for, shall be defrayed by the United States.

Payment to the chief, Timothy.

ARTICLE 6. In consideration of the past services and faithfulness of the Indian chief, Timothy, it is agreed that the United States shall appropriate the sum of six hundred dollars, to aid him in the erection of a house upon the lot of land which may be assigned to him, in accordance with the provisions of the third article of this treaty.

Claims for services and for horses to be paid.

ARTICLE 7. The United States further agree that the claims of certain members of the Nez Percé tribe against the Government for services rendered and for horses furnished by them to the Oregon mounted volunteers, as appears by certificate issued by W. H. Fauntleroy, A. R. Qr. M. and Com. Oregon volunteers, on the 6th of March, 1856, at Camp Cornelius, and amounting to the sum of four thousand six hundred and sixty-five dollars, shall be paid to them in full, in gold coin.

Authority, etc., of the United States acknowledged.

ARTICLE 8. It is also understood that the aforesaid tribe do hereby renew their acknowledgments of dependence upon the Government of the United States, their promises of friendship, and other pledges, as set forth in the eighth article of the treaty of June 11, 1855; and further, that all the provisions of said treaty which are not abrogated or specifically changed by any article herein contained, shall remain the same to all intents and purposes as formerly,—the same obligations resting upon the United States, the same privileges continued to the Indians outside of the reservation, and the same rights secured to citizens of the U. S. as to right of way upon the streams and over the roads which may run through said reservation, as are therein set forth.

Roads and highways.

But it is further provided, that the United States is the only competent authority to declare and establish such necessary roads and highways, and that no other right is intended to be hereby granted to citizens of the United States than the right of way upon or over such roads as may thus be legally established: *Provided, however*, That the roads now usually travelled shall, in the mean time, be taken and deemed as within the meaning of this article, until otherwise enacted by act of Congress or by the authority of the Indian Department.

Hotels and stage stands.

And the said tribe hereby consent, that upon the public roads which may run across the reservation there may be established, at such points as shall be necessary for public convenience, hotels, or stage-stands, of the number and necessity of which the agent or superintendent shall be the sole judge, who shall be competent to license the same, with the privilege of using such amount of land for pasturage and other pur-

[Page 846]

TREATY WITH THE EASTERN SHOSHONI, 1863.

July 2, 1863.

18 Stats., 685.
Ratified Mar. 7, 1864.
Proclaimed June 7, 1869.

Articles of Agreement made at Fort Bridger, in Utah Territory, this second day of July, A. D. one thousand eight hundred and sixty-three, by and between the United States of America, represented by its Commissioners, and the Shoshone nation of Indians, represented by its Chiefs and Principal Men And Warriors of the Eastern Bands, as follows:

ARTICLE 1.

Friendly relations reestablished: perpetual peace.

Friendly and amically relations are hereby re-established between the bands of the Shoshonee nation, parties hereto, and the United States; and it is declared that a firm and perpetual peace shall be henceforth maintained between the Shoshonee nation and the United States.

ARTICLE 2.

Routes of travel; safety of travelers; settlements and posts; offenders.

The several routes of travel through the Shoshonee country, now or hereafter used by white men, shall be and remain forever free and safe for the use of the government of the United States, and of all emigrants and travellers under its authority and Protection, without molestation or injury from any of the people of the said nation. And if depredations should at any time be committed by bad men of their nation, the offenders shall be immediately seized and delivered up to the proper officers of the United States, to be punished as their offences shall deserve; and the safety of all travellers passing peaceably over said routes is hereby guaranteed by said nation. Military agricultural settlements and military posts may be established by the President of the United States along said routes; ferries may be maintained over

[Page 848]

the rivers wherever they may be required; and houses erected and settlements formed at such points as may be necessary for the comfort and convenience of travellers.

ARTICLE 3.

Telegraph and overland stage lines.

The telegraph and overland stage lines having been established and operated through a part of the Shoshonee country, it is expressly agreed that the same may be continued without hindrance, molestation, or injury from the people of said nation; and that their property, and the lives of passengers in the stages, and of the employes of the respective companies, shall be protected by them.

Railway.

And further, it being understood that provision has been made by the Government of the United States for the construction of a railway from the plains west to the Pacific ocean, it is stipulated by said nation that said railway, or its branches, may be located, constructed, and operated, without molestation from them, through any portion of the country claimed by them.

ARTICLE 4.

Boundaries of Shoshoni country.

It is understood the boundaries of the Shoshonee country, as defined and described by said nation, is as follows: On the north, by the mountains on the north side of the valley of Shoshonee or Snake River; on the east, by the Wind River mountains, Peenahpah river, the north fork of Platte or Koo-chin-agah, and the north Park or Buffalo House; and on the south, by Yampah river and the Uintah mountains. The western boundary is left undefined, there being no Shoshonees from that district of country present; but the bands now present claim that their own country is bounded on the west by Salt Lake.

ARTICLE 5.

Annuity: acceptance as a compensation for loss of game.

The United States being aware of the inconvenience resulting to the Indians in consequence of the driving away and destruction of game along the routes travelled by whites, and by the formation of agricultural and mining settlements, are willing to fairly compensate them for the same; therefore, and in consideration of the preceding stipulations, the United States promise and agree to pay to the bands of the Shoshonee nation, parties hereto, annually for the term of twenty years, the sum of ten thousand dollars, in such articles as the President of the United States may deem suitable to their wants and condition, either as hunters or herdsmen. And the said bands of the Shoshonee nation hereby acknowledge the reception of the said stipulated annuities, as a full compensation and equivalent for the loss of game, and the rights and privileges hereby conceded.

ARTICLE 6.

Presents acknowledged.

The said bands hereby acknowledge that they have received from said Commissioners provisions and clothing amounting to six thousand dollars, as presents, at the conclusion of this treaty.

ARTICLE 7.

Amendment.

Nothing herein contained shall be construed or taken to admit any other or greater title or interest in the lands embraced within the territories described in said Treaty with said tribes or bands of Indians than existed in them upon the acquisition of said territories from Mexico by the laws thereof.

S. Doc. 319, 58-2, vol 2——54

[Page 849]

Done at Fort Bridger the day and year above written.

James Duane Doty,
Luther Mann, jr.,
Commissioners.
Washakee, his x mark.
Wanapitz, his x mark.
Toopsapowet, his x mark.
Pantoshiga, his x mark.
Ninabitzee, his x mark.
Narkawk, his x mark.
Taboonshea, his x mark.
Weerango, his x mark.
Tootsahp, his x mark.
Weeahyukee, his x mark.
Bazile, his x mark.

In the presence of—
Jack Robertson, interpreter.
Samuel Dean.

[Page 850]

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TREATY WITH THE SNAKE, 1865.

Aug. 12, 1865.

14 Stat., 683.
Ratified July 5, 1866.
Proclaimed July 10, 1866.

Articles of agreement and convention made and concluded at Sprague River Valley, on this twelfth day of August, in the year one thousand eight hundred and sixty-five, by J. W. Perit Huntington, superintendent of Indian affairs in Oregon, on the part of the United States, and the undersigned chiefs and head-men of the Woll-pah-pe tribe of Snake Indians, acting in behalf of said tribe, being duly authorized so to do.

Peace.

Prisoners and slaves.

ARTICLE 1. Peace is declared henceforth between the United States and the Woll-pah-pe tribe of Snake Indians, and also between said tribe and all other tribes in amity with the United States. All prisoners and slaves held by the Woll-pah-pe tribe, whether the same are white persons or members of Indian tribes in amity with the United States, shall be released; and all persons belonging to the said Woll-pah-pe tribe now held as prisoners by whites, or as slaves by other Indian tribes, shall be given up.

Cession of lands to the United States.

Boundaries.

ARTICLE 2. The said tribe hereby cedes and relinquishes to the United States all their right, title, and interest to the country occupied by them, described as follows, to wit: Beginning at the Snow Peak in the summit of the Blue Mountain range, near the heads of the Grande Ronde River and the north fork of John Day's River; thence down said north fork of John Day's River to its junction with the south fork; thence due south to Crooked River; thence up Crooked River and the south fork thereof to its source; thence southeasterly to Harney Lake; thence northerly to the heads of Malheur and Burnt Rivers; thence continuing northerly to the place of beginning.

Indians to remove to reservation.

ARTICLE 3. The said tribe agree to remove forthwith to the reservation designated by the treaty concluded on the *14th* [15th] of October, 1864, with the Klamath, Moadoc, and Yahooskiu Snake Indians, there to remain under the authority and protection of such Indian agent, or other officer, as the Government of the United States may assign to such duty, and no member of said tribe shall leave said reservation for any purpose without the written consent of the agent or superintendent having jurisdiction over said tribe.

To submit to the United States and not depredate.

Offenders to be given up.

ARTICLE 4. The said Woll-pah-pe tribe promise to be friendly with the people of the United States, to submit to the authority thereof, and to commit no depredations upon the persons or property of citizens thereof, or of other Indian tribes; and should any member of said tribe commit any such depredations, he shall be delivered up to the agent for punishment, and the property restored. If after due notice the tribe

[Page 876]

neglect or refuse to make restitution, or the property is injured or destroyed, compensation may be made by the Government out of the annuities hereinafter provided. In case of any depredation being committed upon the person or property of any member of the aforesaid Woll-pah-pe tribe, it is stipulated that no attempt at revenge, retaliation, or reclamation shall be made by said tribe; but the case shall be reported to the agent or superintendent in charge, and the United States guarantee that such depredation shall be punished in the same manner as if committed against white persons, and that the property shall be restored to the owner.

Wrongs upon Indians, how redressed.

Hostile tribes, sale of arms, etc.

ARTICLE 5. The said tribe promise to endeavor to induce the Hoo-ne-boo-ey and Wa-tat-kah tribes of Snake Indians to cease hostilities against the whites; and they also agree that they will, in no case, sell any arms or ammunition to them nor to any other tribe hostile to the United States.

Fencing and cultivating lands.

Seeds, tools, etc.

ARTICLE 6. The United States agree to expend, for the use and benefit of said tribe, the sum of five thousand dollars to enable the Indians to fence, break up, and cultivate a sufficient quantity of land for their use, to supply them with seeds, farming-implements, domestic animals, and such subsistence as may be necessary during the first year of their residence upon the reservation.

Beneficial expenditures.

ARTICLE 7. The United States also agree to expend, for the use and benefit of said tribe, the sum of two thousand dollars per annum for five years next succeeding the ratification of this treaty, and twelve hundred dollars per annum for the next ten years following, the same to be expended under the direction of the President of the United States for such objects as, in his judgment, will be beneficial to the Indians, and advance them in morals and knowledge of civilization.

Physician, mechanics, etc.

Mill and school houses.

Interpreter.

ARTICLE 8. The said tribe, after their removal to the reservation, are to have the benefit of the services of the physician, mechanics, farmers, teachers, and other employés provided for in the treaty of the 15th October, 1864, in common with the Klamaths, Moadocs, and Yahooskiu Snakes, and are also to have the use of the mills and school-houses provided for in said treaty, so far as may be necessary to them, and not to the disadvantage of the other tribes; and, in addition, an interpreter who understands the Snake language shall be provided by the Government. Whenever, in the judgment of the President, the proper time shall have arrived for an allotment of land in severalty to the Indians upon the said reservation, a suitable tract shall be set apart for each family of the said Woll-pah-pe tribe, and peaceable possession of the same is guaranteed to them.

Possession of ardent spirits on reservation, how punished.

ARTICLE 9. The tribe are desirous of preventing the use of ardent spirits among themselves, and it is therefore provided that any Indian who brings liquor on to the reservation, or who has it in his possession, may in addition to the penalties affixed by law, have his or her proportion of the annuities withheld for such time as the President may determine.

Treaty, when to be obligatory.

ARTICLE 10. This treaty shall be obligatory upon the contracting parties as soon as the same shall be ratified by the Senate of the United States.

In testimony whereof, the said J. W. Perit Huntington, superintendent of Indian affairs, and the undersigned chiefs and headmen of the tribe aforesaid, have hereunto set their signatures and seals, at the place and on the day and year above written.

J. W. Perit Huntington,
Superintendent Indian Affairs in Oregon. [SEAL.]

Pah-ni-ne,	his x mark.	[SEAL.]
Hau-ni-noo-ey,	his x mark.	[SEAL.]
Ki-nau-ney,	his x mark.	[SEAL.]
Wa-ak-chau,	his x mark.	[SEAL.]

[Page 877]

Chok-ko-si,	his x mark.	[SEAL.]
She-zhe,	his x mark.	[SEAL.]
Che-em-ma,	his x mark.	[SEAL.]
Now-hoop-a-cow-.c..,	his x mark.	[SEAL.]
Ki-po-weet-ka,	his x mark.	[SEAL.]
Hau-ne, or Shas-took,	his x mark.	[SEAL.]
Sah-too-too-we,	his x mark.	[SEAL.]

Executed in our presence—

W. V. Rinehart, major First Oregon Infantry.
Wm. Kelly, captain First Cavalry, Oregon Volunteers.
Lindsay Applegate.
Wm. C. McKay, M. D., acting interpreter.
Albert Applegate, second lieutenant, First Oregon Infantry, commanding escort.
F. B. Chase.

[Page 878]

poses connected with such establishment as the agent or superintendent shall deem necessary, it being understood that such lands for pasturage are to be enclosed, and the boundaries thereof described in the license.

And it is further understood and agreed that all ferries and bridges within the reservation shall be held and managed for the benefit of said tribe. Ferries and bridges.

Such rules and regulations shall be made by the Commissioner of Indian Affairs, with the approval of the Secretary of the Interior, as shall regulate the travel on the highways, the management of the ferries and bridges, the licensing of public houses, and the leasing of lands, as herein provided, so that the rents, profits, and issues thereof shall inure to the benefit of said tribe, and so that the persons thus licensed, or necessarily employed in any of the above relations, shall be subject to the control of the Indian Department, and to the provisions of the act of Congress "to regulate trade and intercourse with the Indian tribes, and to preserve peace on the frontiers."

All timber within the bounds of the reservation is exclusively the property of the tribe, excepting that the U. S. Government shall be permitted to use thereof for any purpose connected with its affairs, either in carrying out any of the provisions of this treaty, or in the maintaining of its necessary forts or garrisons. Timber.

The United States also agree to reserve all springs or fountains not adjacent to, or directly connected with, the streams or rivers within the lands hereby relinquished, and to keep back from settlement or entry so much of the surrounding land as may be necessary to prevent the said springs or fountains being enclosed; and, further, to preserve a perpetual right of way to and from the same, as watering places, for the use in common of both whites and Indians. Springs or fountains.

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ARTICLE 10. This treaty shall be obligatory upon the contracting parties as soon as the same shall be ratified by the President and Senate of the United States. Treaty, when to take effect.

In testimony whereof the said C. H. Hale, superintendent of Indian affairs, and Charles Hutchins and S. D. Howe, United States Indian agents in the Territory of Washington, and the chiefs, headmen, and delegates of the aforesaid Nez Perce tribe of Indians, have hereunto set their hands and seals at the place and on the day and year hereinbefore written.

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Fa-Ind-7-1803 Lawyer, Head Chief Nez Perces Nation.	[SEAL.]	We-as-cus, x	[SEAL.]
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Ute-sin-male-e-cum, x	[SEAL.]	Shin-ma-sha-ho-soot, x	[SEAL.]
Ha-harch-tuesta, x	[SEAL.]	Nie-ki-lil-meh-hoom, (Jacob,) x	[SEAL.]
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Timothy, x	[SEAL.]	Wal-la-ta-mana, x	[SEAL.]
Levi, x	[SEAL.]	He-kaikt-il-pilp, x	[SEAL.]
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Wish-la-na-ka-nin, x [SEAL.]
Me-tat-ueptas, (Three Feathers,) x [SEAL.]
Ray-kay-mass, x [SEAL.]

Signed and sealed in presence of—

George F. Whitworth, Secretary.
Justus Steinberger, Colonel U. S. Volunteers.
R. F. Malloy, Colonel Cavalry, O. V.
J. S. Rinearson, Major First Cavalry Oregon Volunteers.
William Kapus, First Lieutenant and Adjutant First W. T. Infantry U. S. Volunteers.
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[Page 848]

TREATY WITH THE NEZ PERCÉS, 1863.

June 9, 1863.

14 Stats., 647.
Ratified Apr. 17, 1867.
Proclaimed Apr. 20, 1867.

Articles of agreement made and concluded at the council-ground, in the valley of the Lapwai, W. T., on the ninth day of June, one thousand eight hundred and sixty-three, between the United States of America, by C. H. Hale, superintendent of Indian affairs, and Charles Hutchins and S. D. Howe, U. S. Indian agents for the Territory of Washington, acting on the part and in behalf of the United States, and the Nez Percé Indians, by the chiefs, head-men, and delegates of said tribe, such articles being supplementary and amendatory to the treaty made between the United States and said tribe on the 11th day of June, 1855.

Cession of lands to the United States.

ARTICLE 1. The said Nez Percé tribe agree to relinquish, and do hereby relinquish, to the United States the lands heretofore reserved for the use and occupation of the said tribe, saving and excepting so much thereof as is described in Article II for a new reservation.

Reservation.

Boundaries.

ARTICLE 2. The United States agree to reserve for a home, and for the sole use and occupation of said tribe, the tract of land included within the following boundaries, to wit: Commencing at the northeast corner of Lake Wa-ha, and running thence, northerly, to a point on the north bank of the Clearwater River, three miles below the mouth of the Lapwai, thence down the north bank of the Clearwater to the mouth of the Hatwai Creek; thence, due north, to a point seven miles distant; thence, eastwardly, to a point on the north fork of the Clearwater, seven miles distant from its mouth; thence to a point on Oro Fino Creek, five miles above its mouth; thence to a point on the north fork of the south fork of the Clearwater, five miles above its mouth; thence to a point on the south fork of the Clearwater, one mile above the bridge, on the road leading to Elk City, (so as to include all the Indian farms now within the forks;) thence in a straight line, westwardly, to the place of beginning.

Reservation to be for the sole use of the tribe, who shall settle thereon within a year.

All of which tract shall be set apart, and the above-described boundaries shall be surveyed and marked out for the exclusive use and benefit of said tribe as an Indian reservation, nor shall any white man, excepting those in the employment of the Indian Department, be permitted to reside upon the said reservation without permission of the tribe and the superintendent and agent; and the said tribe agrees that so soon after the United States shall make the necessary provision for fulfilling the stipulations of this instrument as they can conveniently arrange their affairs, and not to exceed one year from its ratification, they will vacate the country hereby relinquished, and remove to and settle upon the lands herein reserved for them, (except as may be hereinafter provided.) In the meantime it shall be lawful for them to reside upon any ground now occupied or under cultivation by said Indians at this time, and not included in the reservation above named.

Improvements on lands ceded to be paid for.

And it is provided, that any substantial improvement heretofore made by any Indian, such as fields inclosed and cultivated, or houses erected upon the lands hereby relinquished, and which he may be compelled to abandon in consequence of this treaty, shall be valued under the direction of the President of the United States, and payment therefor shall be made in stock or in improvements of an equal value for said Indian upon the lot which may be assigned to him within the bounds of the reservation, as he may choose, and no Indian will be required to abandon the improvements aforesaid, now occupied by him, until said payment or improvement shall have been made.

May be sold to loyal whites.

And it is further provided, that if any Indian living on any of the land hereby relinquished should prefer to sell his improvements to any white man, being a loyal citizen of the United States, prior to the same being valued as aforesaid, he shall be allowed so to do, but the sale or transfer of said improvements shall be made in the presence of, and with the consent

[Page 843]

and approval of, the agent or superintendent, by whom a certificate of sale shall be issued to the party purchasing, which shall set forth the amount of the consideration in kind. Before the issue of said certificate, the agent or superintendent shall be satisfied that a valuable consideration is paid, and that the party purchasing is of undoubted loyalty to the United States Government. No settlement or claim made upon the improved lands by any Indian will be permitted, except as herein provided, prior to the time specified for their removal. Any sale or transfer thus made shall be in the stead of payment for improvements from the United States.

Certificates of sale.

Boundary lines to be marked and lands surveyed into lots.

ARTICLE 3. The President shall, immediately after the ratification of this treaty, cause the boundary-lines to be surveyed, and properly marked and established; after which, so much of the lands hereby reserved as may be suitable for cultivation shall be surveyed into lots of twenty acres each, and every male person of the tribe who shall have attained the age of twenty-one years, or is the head of a family, shall have the privilege of locating upon one lot as a permanent home for such person, and the lands so surveyed shall be allotted under such rules and regulations as the President shall prescribe, having such reference to their settlement as may secure adjoining each other the location of the different families pertaining to each band, so far as the same may be practicable. Such rules and regulations shall be prescribed by the President, or under his direction, as will insure to the family, in case of the death of the head thereof, the possession and enjoyment of such permanent home, and the improvements thereon. When the assignments as above shall have been completed, certificates shall be issued by the Commissioner of Indian Affairs, or under his direction, for the tracts assigned in severalty, specifying the names of the individuals to whom they have been assigned respectively, and that said tracts are set apart for the perpetual and exclusive use and benefit of such assignees and their heirs. Until otherwise provided by law, such tracts shall be exempt from levy, taxation, or sale, and shall be alienable in fee, or leased, or otherwise disposed of, only to the United States, or to persons then being members of the Nez Percé tribe, and of Indian blood, with the permission of the President, and under such regulations as the Secretary of the Interior or the Commissioner of Indian Affairs shall prescribe; and if any such person or family shall at any time neglect or refuse to occupy and till a portion of the land so assigned, and on which they have located, or shall rove from place to place, the President may cancel the assignment, and may also withhold from such person or family their proportion of the annuities or other payments due them until they shall have returned to such permanent home, and resumed the pursuits of industry; and in default of their return, the tract may be declared abandoned, and thereafter assigned to some other person or family of such tribe. The residue of the land hereby reserved shall be held in common for pasturage for the sole use and benefit of the Indians: *Provided, however*, That from time to time, as members of the tribe may come upon the reservation, or may become of proper age, after the expiration of the time of one year after the ratification of this treaty, as aforesaid, and claim the privileges granted under this article, lots may be assigned from the lands thus held in common, wherever the same may be suitable for cultivation. No State or territorial legislature shall remove the restriction herein provided for, without the consent of Congress, and no State or territorial law to that end shall be deemed valid until the same has been specially submitted to Congress for its approval.

Heads of families may locate on lot.

Certificates therefor.

These lots to be exempt from levy, taxes, etc.

Residue to be held in common.

Restriction not to be removed without the consent of Congress.

Payments to the tribe.

ARTICLE 4. In consideration of the relinquishment herein made the United States agree to pay to the said tribe, in addition to the annuities provided by the treaty of June 11, 1855, and the goods and provisions distributed to them at the time of signing this treaty, the

sum of two hundred and sixty-two thousand and five hundred dollars, in manner following, to wit:

First. One hundred and fifty thousand dollars, to enable the Indians to remove and locate upon the reservation, to be expended in the ploughing of land, and the fencing of the several lots, which may be assigned to those individual members of the tribe who will accept the same in accordance with the provisions of the preceding article, which said sum shall be divided into four annual instalments, as follows: For the first year after the ratification of this treaty, seventy thousand dollars; for the second year, forty thousand dollars; for the third year, twenty-five thousand dollars; for the fourth year, fifteen thousand dollars.

Second. Fifty thousand dollars to be paid the first year after the ratification of this treaty in agricultural implements, to include wagons or carts, harness, and cattle, sheep, or other stock, as may be deemed most beneficial by the superintendent of Indian affairs, or agent, after ascertaining the wishes of the Indians in relation thereto.

Third. Ten thousand dollars for the erection of a saw and flouring mill, to be located at Kamia, the same to be erected within one year after the ratification hereof.

Fourth. Fifty thousand dollars for the boarding and clothing of the children who shall attend the schools, in accordance with such rules or regulations as the Commissioner of Indian Affairs may prescribe, providing the schools and boarding-houses with necessary furniture, the purchase of necessary wagons, teams, agricultural implements, tools, &c., for their use, and for the fencing of such lands as may be needed for gardening and farming purposes, for the use and benefit of the schools, to be expended as follows: The first year after the ratification of this treaty, six thousand dollars; for the next fourteen years, three thousand dollars each year; and for the succeeding year, being the sixteenth and last instalment, two thousand dollars.

Fifth. A further sum of two thousand five hundred dollars shall be paid within one year after the ratification hereof, to enable the Indians to build two churches, one of which is to be located at some suitable point on the Kamia, and the other on the Lapwai. Churches.

ARTICLE 5. The United States further agree, that in addition to a head chief the tribe shall elect two subordinate chiefs, who shall assist him in the performance of his public services, and each subordinate chief shall have the same amount of land ploughed and fenced, with comfortable house and necessary furniture, and to whom the same salary shall be paid as is already provided for the head chief in article 5 of the treaty of June 11, 1855, the salary to be paid and the houses and land to be occupied during the same period and under like restrictions as therein mentioned. Subordinate chiefs

And for the purpose of enabling the agent to erect said buildings, and to plough and fence the land, as well as to procure the necessary furniture, and to complete and furnish the house, &c., of the head chief, as heretofore provided, there shall be appropriated, to be expended within the first year after the ratification hereof, the sum of two thousand five hundred dollars.

And inasmuch as several of the provisions of said art. 5th of the treaty of June 11, 1855, pertaining to the erection of school-houses, hospital, shops, necessary buildings for employe[e]s and for the agency, as well as providing the same with necessary furniture, tools, &c., have not yet been complied with, it is hereby stipulated that there shall be appropriated, to be expended for the purposes herein specified during the first year after the ratification hereof, the following sums, to wit: Further appropriation.

First. Ten thousand dollars for the erection of the two schools, including boarding-houses and the necessary out-buildings; said schools to be conducted on the manual-labor system as far as practicable. Schools.

Hospital.

Second. Twelve hundred dollars for the erection of the hospital, and providing the necessary furniture for the same.

Blacksmith's shop, tools, etc.

Third. Two thousand dollars for the erection of a blacksmith's shop, to be located at Kamia, to aid in the completion of the smith's shop at the agency, and to purchase the necessary tools, iron, steel, &c.; and to keep the same in repair and properly stocked with necessary tools and materials, there shall be appropriated thereafter, for the fifteen years next succeeding, the sum of five hundred dollars each year.

Houses, mills, etc.

Fourth. Three thousand dollars for erection of houses for employe[e]s, repairs of mills, shops, &c., and providing necessary furniture, tools, and materials. For the same purpose, and to procure from year to year the necessary articles—that is to say, saw-logs, nails, glass, hardware, &c.—there shall be appropriated thereafter, for the twelve years next succeeding, the sum of two thousand dollars each year; and for the next three years, one thousand dollars each year.

Matrons, teachers, mechanics, millers.

And it is further agreed that the United States shall employ, in addition to those already mentioned in art. 5th of the treaty of June 11, 1855, two matrons to take charge of the boarding-schools, two assistant teachers, one farmer, one carpenter, and two millers.

All the expenditures and expenses contemplated in this treaty, and not otherwise provided for, shall be defrayed by the United States.

Payment to the chief, Timothy.

ARTICLE 6. In consideration of the past services and faithfulness of the Indian chief, Timothy, it is agreed that the United States shall appropriate the sum of six hundred dollars, to aid him in the erection of a house upon the lot of land which may be assigned to him, in accordance with the provisions of the third article of this treaty.

Claims for services and for horses to be paid.

ARTICLE 7. The United States further agree that the claims of certain members of the Nez Percé tribe against the Government for services rendered and for horses furnished by them to the Oregon mounted volunteers, as appears by certificate issued by W. H. Fauntleroy, A. R. Qr. M. and Com. Oregon volunteers, on the 6th of March, 1856, at Camp Cornelius, and amounting to the sum of four thousand six hundred and sixty-five dollars, shall be paid to them in full, in gold coin.

Authority, etc., of the United States acknowledged.

ARTICLE 8. It is also understood that the aforesaid tribe do hereby renew their acknowledgments of dependence upon the Government of the United States, their promises of friendship, and other pledges, as set forth in the eighth article of the treaty of June 11, 1855; and further, that all the provisions of said treaty which are not abrogated or specifically changed by any article herein contained, shall remain the same to all intents and purposes as formerly,—the same obligations resting upon the United States, the same privileges continued to the Indians outside of the reservation, and the same rights secured to citizens of the U. S. as to right of way upon the streams and over the roads which may run through said reservation, as are therein set forth.

Roads and highways.

But it is further provided, that the United States is the only competent authority to declare and establish such necessary roads and highways, and that no other right is intended to be hereby granted to citizens of the United States than the right of way upon or over such roads as may thus be legally established: *Provided, however*, That the roads now usually travelled shall, in the mean time, be taken and deemed as within the meaning of this article, until otherwise enacted by act of Congress or by the authority of the Indian Department.

Hotels and stage stands.

And the said tribe hereby consent, that upon the public roads which may run across the reservation there may be established, at such points as shall be necessary for public convenience, hotels, or stage-stands, of the number and necessity of which the agent or superintendent shall be the sole judge, who shall be competent to license the same, with the privilege of using such amount of land for pasturage and other pur-

poses connected with such establishment as the agent or superintendent shall deem necessary, it being understood that such lands for pasturage are to be enclosed, and the boundaries thereof described in the license.

And it is further understood and agreed that all ferries and bridges within the reservation shall be held and managed for the benefit of said tribe. Ferries and bridges.

Such rules and regulations shall be made by the Commissioner of Indian Affairs, with the approval of the Secretary of the Interior, as shall regulate the travel on the highways, the management of the ferries and bridges, the licensing of public houses, and the leasing of lands, as herein provided, so that the rents, profits, and issues thereof shall inure to the benefit of said tribe, and so that the persons thus licensed, or necessarily employed in any of the above relations, shall be subject to the control of the Indian Department, and to the provisions of the act of Congress "to regulate trade and intercourse with the Indian tribes, and to preserve peace on the frontiers."

All timber within the bounds of the reservation is exclusively the property of the tribe, excepting that the U. S. Government shall be permitted to use thereof for any purpose connected with its affairs, either in carrying out any of the provisions of this treaty, or in the maintaining of its necessary forts or garrisons. Timber.

The United States also agree to reserve all springs or fountains not adjacent to, or directly connected with, the streams or rivers within the lands hereby relinquished, and to keep back from settlement or entry so much of the surrounding land as may be necessary to prevent the said springs or fountains being enclosed; and, further, to preserve a perpetual right of way to and from the same, as watering places, for the use in common of both whites and Indians. Springs or fountains.

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Wow-es-en-at-im, x [SEAL.]
Hiram, x [SEAL.]
Howlish-wampum, x [SEAL.]
Wat-ska-leeks, x [SEAL.]
Wa-lai-tus, x [SEAL.]
Ky-e-wee-pus, x [SEAL.]
Ko-ko-il-pilp, x [SEAL.]
Reuben, Tip-ia-la-na-uy-kala-tsekin, x [SEAL.]
Wish-la-na-ka-nin, x [SEAL.]
Me-tat-ueptas, (Three Feathers,) x [SEAL.]
Ray-kay-mass, x [SEAL.]

Signed and sealed in presence of—

George F. Whitworth, Secretary.
Justus Steinberger, Colonel U. S. Volunteers.
R. F. Malloy, Colonel Cavalry, O. V.
J. S. Rinearson, Major First Cavalry Oregon Volunteers.
William Kapus, First Lieutenant and Adjutant First W. T. Infantry U. S. Volunteers.
Harrison Olmstead.
Jno. Owen, (Bitter Root.)
James O'Neill.
J. B. Buker, M. D.
George W. Elber.
A. A. Spalding, assistant interpreter.
Perrin B. Whitman, interpreter for the council.

[Page 848]

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TREATY WITH THE NEZ PERCÉS, 1868.

Aug. 13, 1868.

15 Stats., 693.
Ratified Feb. 16, 1869.
Proclaimed Feb. 24, 1869.

Whereas certain amendments are desired by the Nez Percé tribe of Indians to their treaty concluded at the council ground in the valley of the Lapwai, in the Territory of Washington, on the ninth day of June, in the year of our Lord one thousand eight hundred and sixty-three; and whereas the United States are willing to assent to said amendments; it is therefore agreed by and between Nathaniel G. Taylor, commissioner, on the part of the United States, thereunto duly authorized, and Lawyer, Timothy, and Jason, chiefs of said tribe, also being thereunto duly authorized, in manner and form following, that is to say:

Reservation.

ARTICLE 1. That all lands embraced within the limits of the tract set apart for the exclusive use and benefit of said Indians by the 2d article of said treaty of June 9th, 1863, which are susceptible of cultivation and suitable for Indian farms, which are not now occupied by the United States for military purposes, or which are not required for agency or other buildings and purposes provided for by existing treaty stipulations, shall be surveyed as provided in the 3d article of said treaty of June 9th, 1863, and as soon as the allotments shall be plowed and fenced, and as soon as schools shall be established as provided by existing treaty stipulations, such Indians now residing outside the reservation as may be decided upon by the agent of the tribe and the Indians themselves, shall be removed to and located upon allotments within the reservation: *Provided, however*, That in case there should not be a sufficient quantity of suitable land within the boundaries of the reservation to provide allotments for those now there and those residing outside the boundaries of the same, then those residing outside, or as many thereof as allotments cannot be provided for, may remain upon the lands now occupied and improved by them, provided, that the land so occupied does not exceed twenty acres for each and every male person who shall have attained the age of twenty-one years or is the head of a family, and the tenure of those remaining upon lands outside the reservation shall be the same as is provided in said 3d article of said treaty of June 9th, 1863, for those receiving

Allotments.

[Page 1024]

allotments within the reservation; and it is further agreed that those now residing outside of the boundaries of the reservation and who may continue to so reside shall be protected by the military anthorities in their rights upon the allotments occupied by them, and also in the privilege of grazing their animals upon surrounding unoccupied lands.

Timber to be protected.

ARTICLE 2. It is further agreed between the parties hereto that the stipulations contained in the 8th article of the treaty of June 9th, 1863, relative to timber, are hereby annulled as far as the same provides that the United States shall be permitted to use thereof in the maintaining of forts or garrisons, and that the said Indians shall have the aid of the military authorities to protect the timber upon their reservation, and that none of the same shall be cut or removed without the consent of the head-chief of the tribe, together with the consent of the agent and superintendent of Indian affairs, first being given in writing, which written consent shall state the part of the reservation upon which the timber is to be cut, and also the quantity, and the price to be paid therefor.

School moneys, etc.

ARTICLE 3. It is further hereby stipulated and agreed that the amount due said tribe for school purposes and for the support of teachers that has not been expended for that purpose since the year 1864, but has been used for other purposes, shall be ascertained and the same shall be re-imbursed to said tribe by appropriation by Congress, and shall be set apart and invested in United States bonds and shall be held in trust by the United States, the interest on the same to be paid to said tribe annually for the support of teachers.

In testimony whereof the said Commissioner on the part of the United States and the said chiefs representing said Nez Percé tribe of Indians have hereunto set their hands and seals this 13th day of August, in the year of our Lord one thousand eight hundred and sixty-eight, at the city of Washington, D. C.

N. G. Taylor, [L. S.]
Commissioner Indian Affairs.
Lawyer, Head Chief Nez Percés. [L. S.]
Timothy, his x mark, Chief. [L. S.]
Jason, his x mark, Chief. [L. S.]

In presence of—
Charles E. Mix.
Robert Newell, United States Agent.
W. R. Irwin.

TREATY WITH THE EASTERN BAND SHOSHONI AND BANNOCK, 1868.

July 3, 1868.

15 Stat., 673.
Ratified Feb. 26, 1869.
Proclaimed Feb. 24, 1869.

Articles of a treaty made and concluded at Fort Bridger, Utah Territory, on the third day of July, in the year of our Lord one thousand eight hundred and sixty-eight, by and between the undersigned commissioners on the part of the United States, and the undersigned chiefs and head-men of and representing the Shoshonee (eastern band) and Bannack tribes of Indians, they being duly authorized to act in the premises:

Peace and friendship.

ARTICLE 1. From this day forward peace between the parties to this treaty shall forever continue. The Government of the United States desires peace, and its honor is hereby pledged to keep it. The Indians desire peace, and they hereby pledge their honor to maintain it.

Offenders among the whites to be arrested and punished.

If bad men among the whites, or among other people subject to the authority of the United States, shall commit any wrong upon the person or property of the Indians, the United States will, upon proof made to the agent and forwarded to the Commissioner of Indian Affairs, at Washington City, proceed at once to cause the offender to be arrested and punished according to the laws of the United States, and also re-imburse the injured person for the loss sustained.

Among the Indians to be given up to the United States, etc.

If bad men among the Indians shall commit a wrong or depredation upon the person or property of any one, white, black, or Indian, subject to the authority of the United States, and at peace therewith, the Indians herein named solemnly agree that they will, on proof made to their agent and notice by him, deliver up the wrong-doer to the United States, to be tried and punished according to the laws; and in case they wilfully refuse so to do, the person injured shall be re-imbursed for his loss from the annuities or other moneys due or to become due to them under this or other treaties made with the United States. And the President, on advising with the Commissioner of Indian Affairs, shall prescribe such rules and regulations for ascertaining damages under the provisions of this article as in his judgment may be proper. But no such damages shall be adjusted and paid until thoroughly examined and passed upon by the Commissioner of Indian Affairs, and no one sustaining loss while violating or because of his violating the provisions of this treaty or the laws of the United States, shall be reimbursed therefor.

Rules for ascertaining damages.

Reservation.

ARTICLE 2. It is agreed that whenever the Bannacks desire a reservation to be set apart for their use, or whenever the President of the United States shall deem it advisable for them to be put upon a reservation, he shall cause a suitable one to be selected for them in their present country, which shall embrace reasonable portions of the "Port Neuf" and "Kansas Prairie" countries, and that, when this reservation is declared, the United States will secure to the Bannacks the same rights and privileges therein, and make the same and like expenditures therein for their benefit, except the agency-house and residence of agent, in proportion to their numbers, as herein provided for the Shoshonee reservation. The United States further agrees that the follow-

ing district of country, to wit: Commencing at the mouth of Owl Creek and running due south to the crest of the divide between the Sweetwater and Papo Agie Rivers; thence along the crest of said divide and the summit of Wind River Mountains to the longitude of North Fork of Wind River; thence due north to mouth of said North Fork and up its channel to a point twenty miles above its mouth; thence in a straight line to head-waters of Owl Creek and along middle of channel of Owl Creek to place of beginning, shall be and the same is set apart for the absolute and undisturbed use and occupation of the Shoshonee Indians herein named, and for such other friendly tribes or individual Indians as from time to time they may be willing, with the consent of the United States, to admit amongst them; and the United States now solemnly agrees that no persons except those herein designated and authorized so to do, and except such officers, agents, and employés of the Government as may be authorized to enter upon Indian reservations in discharge of duties enjoined by law, shall ever be permitted to pass over, settle upon, or reside in the territory described in this article for the use of said Indians, and henceforth they will and do hereby relinquish all title, claims, or rights in and to any portion of the territory of the United States, except such as is embraced within the limits aforesaid.

Boundaries.

Who not to reside thereon.

ARTICLE 3. The United States agrees, at its own proper expense, to construct at a suitable point of the Shoshonee reservation a warehouse or store-room for the use of the agent in storing goods belonging to the Indians, to cost not exceeding two thousand dollars; an agency building for the residence of the agent, to cost not exceeding three thousand; a residence for the physician, to cost not more than two thousand dollars; and five other buildings, for a carpenter, farmer, blacksmith, miller, and engineer, each to cost not exceeding two thousand dollars; also a school-house or mission building so soon as a sufficient number of children can be induced by the agent to attend school, which shall not cost exceeding twenty-five hundred dollars.

Buildings to be erected by the United States.

The United States agrees further to cause to be erected on said Shoshonee reservation, near the other buildings herein authorized, a good steam circular-saw mill, with a grist-mill and shingle-machine attached, the same to cost not more than eight thousand dollars.

Mills.

ARTICLE 4. The Indians herein named agree, when the agency house and other buildings shall be constructed on their reservations named, they will make said reservations their permanent home, and they will make no permanent settlement elsewhere; but they shall have the right to hunt on the unoccupied lands of the United States so long as game may be found thereon, and so long as peace subsists among the whites and Indians on the borders of the hunting districts.

Reservation to be permanent home of Indians.

ARTICLE 5. The United States agrees that the agent for said Indians shall in the future make his home at the agency building on the Shoshonee reservation, but shall direct and supervise affairs on the Bannack reservation; and shall keep an office open at all times for the purpose of prompt and diligent inquiry into such matters of complaint by and against the Indians as may be presented for investigation under the provisions of their treaty stipulations, as also for the faithful discharge of other duties enjoined by law. In all cases of depredation on person or property he shall cause the evidence to be taken in writing and forwarded, together with his finding, to the Commissioner of Indian Affairs, whose decision shall be binding on the parties to this treaty.

Agent to make his home and reside where.

ARTICLE 6. If any individual belonging to said tribes of Indians, or legally incorported with them, being the head of a family, shall desire to commence farming, he shall have the privilege to select, in the presence and with the assistance of the agent then in charge, a tract of land within the reservation of his tribe, not exceeding three hundred

Heads of families desiring to commence farming may select lands, etc.

[Page 1021]

and twenty acres in extent, which tract so selected, certified, and recorded in the "land-book," as herein directed, shall cease to be held in common, but the same may be occupied and held in the exclusive possession of the person selecting it, and of his family, so long as he or they may continue to cultivate it.

Effect of such selection.

Persons not heads of families.

Any person over eighteen years of age, not being the head of a family, may in like manner select and cause to be certified to him or her, for purposes of cultivation, a quantity of land not exceeding eighty acres in extent, and thereupon be entitled to the exclusive possession of the same as above described. For each tract of land so selected a a certificate, containing a description thereof, and the name of the person selecting it, with a certificate indorsed thereon that the same has been recorded, shall be delivered to the party entitled to it by the agent, after the same shall have been recorded by him in a book to be kept in his office subject to inspection, which said book shall be known as the "Shoshone (eastern band) and Bannack land-book."

Certificates of selection to be delivered, etc., to be recorded.

Survey.

The President may at any time order a survey of these reservations, and when so surveyed Congress shall provide for protecting the rights of the Indian settlers in these improvements, and may fix the character of the title held by each. The United States may pass such laws on the subject of alienation and descent of property as between Indians, and on all subjects connected with the government of the Indians on said reservations, and the internal police thereof, as may be thought proper.

Alienation and descent of property.

Children between 6 and 16 to attend school.

ARTICLE 7. In order to insure the civilization of the tribes entering into this treaty, the necessity of education is admitted, especially of such of them as are or may be settled on said agricultural reservations, and they therefore pledge themselves to compel their children, male and female, between the ages of six and sixteen years, to attend school; and it is hereby made the duty of the agent for said Indians to see that this stipulation is strictly complied with; and the United States agrees that for every thirty children between said ages who can be induced or compelled to attend school, a house shall be provided and a teacher competent to teach the elementary branches of an English education shall be furnished, who will reside among said Indians and faithfully discharge his or her duties as a teacher. The provisions af this article to continue for twenty years.

Duty of agent.

Schoolhouses and teachers.

Seeds and agricultural implements.

ARTICLE 8. When the head of a family or lodge shall have selected lands and received his certificate as above directed, and the agent shall be satisfied that he intends in good faith to commence cultivating the soil for a living, he shall be entitled to receive seeds and agricultural implements for the first year, in value one hundred dollars, and for each succeeding year he shall continue to farm, for a period of three years more, he shall be entitled to receive seeds and implements as aforesaid in value twenty-five dollars per annum.

Instructions in farming.

And it is further stipulated that such persons as commence farming shall receive instructions from the farmers herein provided for, and whenever more than one hundred persons on either reservation shall enter upon the cultivation of the soil, a second blacksmith shall be provided, with such iron, steel, and other material as may be required.

Second blacksmith.

Delivery of articles in lieu of money and annuities.

ARTICLE 9. In lieu of all sums of money or other annuities provided to be paid to the Indians herein named, under any and all treaties heretofore made with them, the United States agrees to deliver at the agency-house on the reservation herein provided for, on the first day of September of each year, for thirty years, the following articles, to wit:

Clothing, etc.

For each male person over fourteen years of age, a suit of good substantial woollen clothing, consisting of coat, hat, pantaloons, flannel shirt, and a pair of woollen socks; for each female over twelve years of age, a flannel skirt, or the goods necessary to make it, a pair

[Page 1022]

of woollen hose, twelve yards of calico; and twelve yards of cotton domestics.

For the boys and girls under the ages named, such flannel and cotton goods as may be needed to make each a suit as aforesaid, together with a pair of woollen hose for each.

Census.

And in order that the Commissioner of Indian Affairs may be able to estimate properly for the articles herein named, it shall be the duty of the agent each year to forward to him a full and exact census of the Indians, on which the estimate from year to year can be based; and in addition to the clothing herein named, the sum of ten dollars shall be annually appropriated for each Indian roaming and twenty dollars for each Indian engaged in agriculture, for a period of ten years, to be used by the Secretary of the Interior in the purchase of such articles as from time to time the condition and necessities of the Indians may indicate to be proper. And if at any time within the ten years it shall appear that the amount of money needed for clothing under this article can be appropriated to better uses for the tribes herein named, Congress may by law change the appropriation to other purposes; but in no event shall the amount of this appropriation be withdrawn or discontinued for the period named. And the President shall annually detail an officer of the Army to be present and attest the delivery of all the goods herein named to the Indians, and he shall inspect and report on the quantity and quality of the goods and the manner of their delivery.

May be changed.

Army officer to attest delivery of goods, etc.

Physician, teachers, carpenter, etc.

ARTICLE 10. The United States hereby agrees to furnish annually to the Indians the physician, teachers, carpenter, miller, engineer, farmer, and blacksmith, as herein contemplated, and that such appropriations shall be made from time to time, on the estimates of the Secretary of the Interior, as will be sufficient to employ such persons.

Cession of reservation not to be valid unless, etc.

ARTICLE 11. No treaty for the cession of any portion of the reservations herein described which may be held in common shall be of any force or validity as against the said Indians, unless executed and signed by at least a majority of all the adult male Indians occupying or interested in the same; and no cession by the tribe shall be understood or construed in such manner as to deprive without his consent, any individual member of the tribe of his right to any tract of land selected by him. as provided in Article 6 of this treaty.

Presents for most valuable crops.

ARTICLE 12. It is agreed that the sum of five hundred dollars annually, for three years from the date when they commence to cultivate a farm, shall be expended in presents to the ten persons of said tribe who, in the judgment of the agent, may grow the most valuable crops for the respective year.

ARTICLE 13. It is further agreed that until such time as the agency-buildings are established on the Shoshonee reservation, their agent shall reside at Fort Bridger, U. T., and their annuities shall be delivered to them at the same place in June of each year.

N. G. Taylor, [SEAL.]
W. T. Sherman, [SEAL.]
Lieutenant-General.
Wm. S. Harney, [SEAL.]
John B. Sanborn, [SEAL.]
S. F. Tappan, [SEAL.]
C. C. Augur, [SEAL.]
Brevet Major-General, U. S. Army, Commissioners.
Alfred H. Terry, [SEAL.]
Brigadier-General and Brevet Major-General, U. S. Army.

Attest:
A. S. H. White, Secretary.

[Page 1023]

Shoshones:

	Wash-a-kie,	his x mark.
	Wau-ny-pitz,	his x mark.
	Toop-se-po-wot,	his x mark.
	Nar-kok,	his x mark.
	Taboonshe-ya,	his x mark.
	Bazeel,	his x mark.
	Pan-to-she-ga,	his x mark.
	Ninny-Bitse,	his x mark.

Bannacks:

	Taggee,	his x mark.
	Tay-to-ba,	his x mark.
	We-rat-ze-won-a-gen,	his x mark.
	Coo-sha-gan,	his x mark.
	Pan-sook-a-motse,	his x mark.
	A-wite-etse,	his x mark.

Witnesses:

Henry A. Morrow,
Lieutenant-Colonel Thirty-sixth Infantry and
Brevet Colonel U. S. Army, Commanding Fort Bridger.
Luther Manpa, United States Indian agent.
W. A. Carter.
J. Van Allen Carter, interpreter.

[Page 1024]

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US Army Corps
of Engineers®
Walla Walla District

Final

Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

Appendix R

Historical Perspectives

February 2002

US Army Corps
of Engineers®
Walla Walla District

Final
Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

Appendix R
Historical Perspectives

Produced by

Foster Wheeler Environmental Corporation and Historical Research Associates

Produced for

U.S. Army Corps of Engineers
Walla Walla District

February 2002

Appendix R

FOREWORD

Appendix R was prepared by Foster Wheeler Environmental Corporation and Historical Research Associates in conjunction with the U.S. Army Corps of Engineers' (Corps) study team. This appendix is one part of the overall effort of the Corps to prepare the Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (FR/EIS).

The Corps has reached out to regional stakeholders (Federal agencies, tribes, states, local governmental entities, organizations, and individuals) during the development of the FR/EIS and appendices. This effort resulted in many of these regional stakeholders providing input and comments, and even drafting work products or portions of these documents. This regional input provided the Corps with an insight and perspective not found in previous processes. A great deal of this information was subsequently included in the FR/EIS and appendices; therefore, not all of the opinions and/or findings herein may reflect the official policy or position of the Corps.

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TABLE OF CONTENTS

TABLE OF CONTENTS

FIGURES

ACRONYMS AND ABBREVIATIONS

ANCOOR	Analytical Coordination Work Group
BA	biological assessment
BOR	U.S. Bureau of Reclamation
BPA	Bonneville Power Administration
CEQ	Council on Environmental Quality
Corps	U.S. Army Corps of Engineers
CRBFWP	Columbia River Basin Fish and Wildlife Program
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FCRPS	Federal Columbia River Power System
FEIS	Final Environmental Impact Statement
flip lips	spillway flow deflectors
FR	Feasibility Report
FR/EIS	Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement
IDFG	Idaho Department of Fish and Game
IDFG v. NMFS	*Idaho Department of Fish and Game v. National Marine Fisheries Service*
ISG	Independent Scientific Group
MOA	Memorandum of Agreement
MOP	minimum operating pool
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPPC	Northwest Power Planning Council
OA/EIS	Columbia River Salmon Flow Measures Options Analysis/Environmental Impact Statement
PATH	Plan for Analyzing and Testing Hypotheses
PNCA	Pacific Northwest Coordination Agreement
ROD	Record of Decision
SBC	surface bypass collector
SCS	System Configuration Study
SEIS	Supplemental Environmental Impact Statement
SOR	System Operation Review
SOS	System Operating Strategies
SRSRT	Snake River Salmon Recovery Team
TAG	Technical Advisory Group
USFWS	U.S. Fish and Wildlife Service

ENGLISH TO METRIC CONVERSION FACTORS

To Convert From	To	Multiply By
LENGTH CONVERSIONS:		
Inches	Millimeters	25.4
Feet	Meters	0.3048
Miles	Kilometers	1.6093
AREA CONVERSIONS:		
Acres	Hectares	0.4047
Acres	Square meters	4047
Square Miles	Square kilometers	2.590
VOLUME CONVERSIONS:		
Gallons	Cubic meters	0.003785
Cubic yards	Cubic meters	0.7646
Acre-feet	Hectare-meters	0.1234
Acre-feet	Cubic meters	1234
OTHER CONVERSIONS:		
Feet/mile	Meters/kilometer	0.1894
Tons	Kilograms	907.2
Tons/square mile	Kilograms/square kilometer	350.2703
Cubic feet/second	Cubic meters/sec	0.02832
Degrees Fahrenheit	Degrees Celsius	(Deg F –32) x (5/9)

Executive Summary

This appendix provides a historical perspective on the development and changes in hydropower, habitat, hatcheries, and harvest since the mid-19th century and a summary of significant events and documents related to salmon restoration efforts in the Federal Columbia River Power System (FCRPS) since 1990.

The public perception of what is meant by "conservation" has changed significantly since the mid-19th century. To the Euroamericans that first arrived on the Columbia and Snake Rivers, conservation meant that natural resources were used in an efficient and sustainable manner. Resources such as soil (for agriculture), timber, fish, stream beds (for mining), and water were considered economic commodities. The development of railroads increased access to both natural resources and to expanding markets eager to consume these commodities. Many natural resources seemed inexhaustible and the ecological effects of their exploitation were poorly understood.

This early view of natural resources and the desire for economic expansion resulted in the development of the timber, mining, and agricultural industries. During the development of these industries and the general expansion of the population in the Columbia River Basin, salmon habitat quality and quantity declined as a result of reductions in large woody debris, increases in sediment fines, direct (e.g., dikes, channel straightening, etc.) and indirect (i.e., from flow and sediment load) changes in stream morphology, modifications of water flow, and decreased water quality. At the same time technological advances made the harvesting and storage of salmon more efficient and widely available to the growing American population. No significant regulation of these industries other than fisheries occurred until the latter half of the 20th century.

The first of the Federal dams, Bonneville Dam, was constructed in 1938 and additional multipurpose dams were built through the 1970s. The FCRPS and Bureau of Reclamation (BOR) dams provided cheap electricity, flood control, irrigation, and in-river water transportation to the region. The hydrosystem contributed to the development of industries such as aluminum smelting that relied heavily on electricity, and those that needed water during seasons with naturally low rainfall and streamflow. Many dams were built under the assumption that technology in the form of fish passage facilities and hatcheries could mitigate for adverse effects to salmon populations.

Initially, only a small minority of the public was concerned about the adverse effects to salmon from hydropower, industry, fish harvest, and hatchery development. However, in the 1970s, the decade that included enactment of the Endangered Species Act (ESA) and the Clean Water Act, the public perception of "conservation" began to shift more towards the conservation of species and ecosystems for their own sake. In addition, it became more widely recognized during succeeding decades that the cumulative effects of economic development in the Columbia River Basin were causing declines in highly valued species such as salmon to the point where many populations were on the brink of extirpation or were already gone.

Federal, state, local government, and citizen efforts to recover salmon populations accelerated during the 1990s. The first significant event of the 1990s was the Northwest Salmon Summit, which was convened in 1990 to address the problem of declining salmon stocks and to reach a consensus among diverse Pacific Northwest interests.

In the ensuing years, three species of Northwest anadromous fish were listed as threatened or endangered on the Snake River: sockeye salmon were listed as endangered in 1991; chinook were listed as threatened in 1992; and steelhead were listed as threatened in 1996. Overall, 12 separate runs are currently listed in the Columbia River System.

Many agencies and groups are involved in the anadromous fish issues of the Columbia River Basin. These include the U.S. Army Corps of Engineers (Corps), Bonneville Power Administration (BPA), National Marine Fisheries Service (NMFS), BOR, and U.S. Fish and Wildlife Service (USFWS). Additionally, several groups have formed specifically to study these issues:

- **The Northwest Power Planning Council (NPPC)** was formed in 1980 and is composed of representatives from Idaho, Montana, Oregon, and Washington. The NPPC is responsible for finding ways to acquire and market new power sources while giving equitable treatment to fish and wildlife. The NPPC issued the Columbia River Basin Fish and Wildlife Program in 1982. The program addresses salmon and steelhead production, safe passage, harvest management, resident fish and wildlife protection, future hydroelectric development, and coordination among Federal agencies responsible for Columbia River Basin resources. The NPPC makes annual funding recommendations to the BPA for projects to implement for protecting, mitigating, or enhancing fish and wildlife in the Columbia River Basin that have been negatively affected by hydroelectric dams.

- **The Snake River Salmon Recovery Team (SRSRT)** was appointed by NMFS to independently develop recommendations for a recovery plan for the Snake River sockeye and chinook salmon. NMFS used these recommendations in the development of the recovery plan issued in 1995.

- **The Independent Scientific Group (ISG)** was funded by BPA to conduct a biennial review of the science underlying salmon and steelhead recovery efforts. The ISG issued a 1996 report that provides a scientific foundation for public policy to be developed by NPPC.

- **The Analytical Coordination Work Group (ANCOOR)** consists of fishery modelers from NMFS, BPA, NPPC, the Corps, states, and tribes. The objective of this group is to compare and enhance smolt passage survival and lifecycle models used within the region. ANCOOR was formed in 1993.

Several environmental impact statements (EISs) and related documents have been developed by the Corps in the 1990s, with the BPA, BOR, or NMFS as cooperating agencies:

- The Columbia River Salmon Flow Measures Options Analysis EIS (OA/EIS) (issued in 1992) evaluated the effects of operational changes at certain Federal multipurpose water projects in the FCRPS. The Corps also prepared a biological assessment (BA) of whether the proposed actions would jeopardize listed species. NMFS reviewed this information and issued a biological opinion that the proposed operations were not likely to jeopardize the existence of listed or proposed salmon species. The Corps then issued a Record of Decision (ROD) that described its Operations Plan for 1992.

- The Interim Columbia and Snake Rivers Flow Improvement Measures for Salmon Final Supplemental Environmental Impact Statement (SEIS) was prepared by the Corps in 1993. It addressed issues similar to the 1992 EIS, but evaluated effects of actions occurring over a longer period of time and included some projects not addressed in the 1992 OA/EIS. The

preferred alternative recommended some changes to the 1992 Operating Plan. Included in the alternatives was a biological drawdown test of Lower Granite Dam on the lower Snake River. A companion EIS was developed specifically for a series of biological drawdown tests, but was never completed because juvenile salmon were shown to have a high survival rate (over 90 percent) through the dam.

- The System Configuration Study (SCS) was initiated by the Corps in 1991 to evaluate the technical, environmental, and economic effects of potential modifications to the configuration of Federal dams and reservoirs. The Lower Snake River Juvenile Salmon Migration Feasibility Study, described in this EIS, is one of several studies conducted under this program. This study was initiated in 1994 to specifically evaluate the technical, environmental, social, and economic effects of potential modification to four projects on the lower Snake River. Additional studies are evaluating other projects on the Columbia and Snake Rivers.
- The Columbia River System Operation Review (SOR) was initiated in 1990 by the Corps, BPA, and BOR to review multipurpose management of the Columbia-Snake River System and provide a strategy for system operation. The final EIS was issued in 1995.
- NMFS issued two more biological opinions on operations of the Columbia River System: the 1993 biological opinion was based on 1993 operations, and the 1994 biological opinion was based on operations from 1994 through 1999. Again, both opinions ultimately indicated that operations were not likely to jeopardize the continued existence of the endangered or threatened Snake River salmon. After the 1993 opinion was challenged and overturned in the courts, NMFS issued a new opinion in 1995 indicating that operations were likely to jeopardize the salmon and that long-term system reconfigurations were necessary. The NMFS 1995 Biological Opinion also included an alternative to the proposed action of the 1993 EIS; this alternative requested that the Corps evaluate one of three drawdown scenarios and implement surface collectors. In 1995, the Corps issued a ROD that stated its intentions to follow through with NMFS' recommendations as quickly as possible.
- In May 1998, NMFS issued the Supplemental FCRPS biological opinion. This opinion evaluated the effects of the configuration and operation of the FCRPS on newly listed threatened or endangered steelhead in the Columbia River, Snake River, and lower Columbia River. Other supplemental opinions were issued in 1999 and 2000. For both of these, the long-term decision-making process was unchanged from that set forth in the 1995 biological opinion.
- In December 1999, the Corps, BPA, and BOR issued a BA of the entire FCRPS. This BA was prepared in response to the decision-making process established in the 1995 biological opinion.
- In December 2000, two biological opinions were issued in response to the 1999 BA. One was prepared by NMFS and addressed anadromous species in the Columbia River Basin. The second was issued by USFWS and focused on bull trout in the FCRPS and Kootenai River sturgeon. The Corps, BPA, and BOR are currently reviewing the two opinions and are preparing an implementation plan.

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1. Introduction

The U.S. Army Corps of Engineers' (Corps) Lower Snake River Juvenile Salmon Migration Feasibility Study (the current study) was initiated in 1994 to evaluate the technical, environmental, social, and economic effects of potential modifications to the configuration (structural components and their arrangement) of four Federal facilities (Ice Harbor, Lower Monumental, Little Goose, Lower Granite) on the lower Snake River. The intent of these modifications is to increase the survival of juvenile anadromous fish as they migrate through the Lower Snake River Hydropower Project.

The current study is not an isolated project. It is one part of a large, multiyear, multiagency effort to restore salmon stocks in the Federal Columbia River Power System (FCRPS). The Corps is playing a significant role in this effort, along with the Bonneville Power Administration (BPA), the Bureau of Reclamation (BOR), the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS). To understand the purpose, role, and goals of this specific study, it is helpful to understand the general historical and technical context. In addition to the Federal agencies listed above that have a direct responsibility for the FCRPS, other Federal agencies such as the Environmental Protection Agency (EPA) and USDA Forest Service have also influenced Federal policy in the Columbia River Basin and are important for recovery of listed salmon species. Also, state agencies from Washington, Oregon, Idaho, and Montana; industry; academia; and citizens have influenced the management of salmon and steelhead species that are the focus of the current study.

The following sections are provided to give historical context to the current study. Section 2 is a synopsis of public and management perspectives since the mid-19th century and examines the development and changes in hydropower, habitat, hatcheries, and harvest. It also explores changes in how the public perception of "conservation" has changed over that period. Section 3 provides a summarization of significant events and documents from 1990 to the present related to salmon restoration efforts in the FCRPS. The most significant events and documents are highlighted on Figure 1-1.

Figure 1-1. Chronology of Significant Salmon Recovery-related Events and Documents Since 1990

1990

- **April** — Petition submitted to list Snake River sockeye as endangered under ESA
- **June** — Petition submitted to list Snake River spring/summer and fall chinook as threatened under ESA
- **July** — Columbia River SOR initiated
- **October** — Salmon Summit begins

1991

- **November** — Snake River sockeye listed as endangered under ESA
- **December** — NPPC, Phase II Amendments to Fish and Wildlife Program completed and issued

1992

- **January** — Columbia River Salmon Flow Measures OA/EIS issued
- **March** — Corps conducts drawdown test of Lower Granite and Little Goose reservoirs
- **April** — Snake River spring/summer and fall chinook listed as threatened under ESA
- **February** — Corps issues ROD to implement drawdown test of Lower Granite and Little Goose reservoirs
- **March** — System Configuration Study, Phase I initiated
- **April** — NMFS issues "no jeopardy" Biological Opinion on Proposed 1992 Operations of FCRPS
- **April** — Corps issues ROD on Proposed 1992 Operations of the FCRPS

1993

- **May** — NMFS issues "no jeopardy" Biological Opinion on Proposed 1993 Operations of the FCRPS
- **December** — ESA critical habitat for Snake River sockeye, spring/summer chinook, and fall chinook designated
- **Throughout Year** — Formation of regional forums to begin providing input into salmon processes (i.e., PATH)
- **March** — Interim Columbia and Snake Rivers Flow Improvement Measures for Salmon Supplemental EIS issued
- **June** — Corps issues ROD on Proposed 1993 Operations of the FCRPS

Figure 1-1. Chronology of Significant Salmon Recovery-related Events and Documents Since 1990 (continued)

1994

March
NMFS issues "no jeopardy" Biological Opinion on Proposed 1994 to 1999 Operations of the FCRPS

April
Federal District Court sets aside NMFS' Biological Opinion on Proposed 1993 Operations of FCRPS and the Corps and BoR RODs, and orders preparation of new Biological Opinion and RODs

August
NMFS issues a proposed rule to list spring/summer chinook and fall chinook as endangered but later (1998) withdraws it, leaving the stocks listed as threatened

April
Lower Snake River Biological Drawdown Test Draft EIS issued

May
Snake River Salmon Recovery Team issues final recommendations to NMFS

November
Lower Snake River Juvenile Salmon Migration Feasibility Study initiated as part of the System Configuration Study, Phase II

1995

March
Corps issues ROD on FCRPS Operations for 1995 and future years

November
Final EIS for the Columbia River SOR issued

March
NMFS issues new Biological Opinion on 1995 to 1998 Operation of FCRPS, finding jeopardy to listed salmon stocks and recommending "Reasonable and Prudent Alternatives"

March
NMFS issues Proposed Recovery Plan for Snake River salmon

1996

September
Independent Scientific Group review of NPPC's Fish and Wildlife Program issued

August
Snake River wild steelhead proposed for threatened listing under ESA

December
Lower Snake River Juvenile Salmon Migration Feasibility Study, Interim Status Report issued

Figure 1-1. Chronology of Significant Salmon Recovery-related Events and Documents Since 1990 (continued)

1997

August
Snake River steelhead listed as threatened; Upper Columbia River steelhead listed as endangered

1998

March
Lower Columbia River steelhead listed as endangered

May
NMFS issues 1998 Supplemental FCRPS Biological Opinion on steelhead listed in August 1997

November
NPPC Multi-species Framework Project initiated

November
Oregon voters approve the Oregon Plan

1999

March
Upper Colombia River spring chinook listed as endangered; Upper Willamette chinook, Lower Columbia River chinook, Middle Columbia River steelhead, Upper Willamette River steelhead, and Columbia River chum listed (all) as threatened

September
Washington releases the Statewide Strategy to Salmon Recovery, "Extinction is Not a Option"

December
Supplemental Biological Opinion Issued on flow augmentation and operation of BOR projects above Lower Granite

December
Corps, BPA, and BOR issue BA on FCRPS

Federal Caucus releases the "All-H Paper"

December
Corps releases Draft Lower Snake Juvenile Salmon Migration Feasilbity Repor/Environmental Impact Statement

2000

February
Supplemental Biological Opinion issued on six species listed in March 1999

April
2000 NPPL Columbia River fish and wildlife program

December
NMFS and USFWS issue separate Biological Opinions on operations of FCRPS

December
Federal Caucus releases "Final Basinwide Salmon Recovery Strategy"

2001

May
Corps issues Record of Consultation and Statement of Decision

2. Historical Perspectives

Attitudes toward the natural world have changed considerably over the last 150 years. If the Euroamericans who arrived on the Columbia and Snake Rivers during the mid-19th century could witness the debates regarding Pacific salmon in the 21st century, they might be astonished at the contrast in priorities and values. The first white settlers viewed salmon as an inexhaustible resource, and they devoted their energies to increasing the efficiency of harvest methods and transportation systems rather than considering the need to protect the region's fisheries.

By the late 19th century, far-sighted individuals had warned that some salmon species were headed for extinction, but their message was not widely heeded. The Federal government encouraged the perception that the nation could enjoy the fruits of development and continue to have fish too. Conservationists even advocated using the region's water, timber, and fisheries resources to the fullest extent. Not until the environmental era of the 1960s and 1970s did the region recognize the limitations of its resources, prompting dramatic changes in fisheries policy and management. Ideas leave their mark on land and water as surely as dams, logging trucks, and fish traps. The following sections describe the development of attitudes in the Pacific Northwest, providing historical background for the four primary contributors to salmon decline: hydroelectric development, habitat degradation, harvests, and hatcheries.

2.1 Hydroelectric Development

"Your power is turning our darkness to dawn,
So roll on, Columbia, roll on."
—Woody Guthrie

Few subjects are more controversial in the Pacific Northwest today than dams and their impacts on salmon. Public debate on this issue is widespread; major newspapers in Walla Walla, Portland, and Seattle have devoted considerable coverage to it during the last 30 years. These newspaper articles reveal a range of perceptions, from a view of dams as "river killers" to assertions that the problem of declining salmon is a great "hoax." Scientists, engineers, and policy-makers have long discussed the pros and cons of large multipurpose dam development on the Columbia and Snake Rivers. What has changed in recent years is the perception of urgency and the increased questioning of choices that the region made during the early and mid 20th century.

Many Americans welcomed the arrival of the first large multipurpose dams in the Columbia River Basin. No 20th-century development brought more economic benefits to the Pacific Northwest than the hydroelectric projects along the Columbia and Snake Rivers. The Federal government funded the construction of large multipurpose dams on the lower Columbia and Snake Rivers, as these projects remained beyond the financial reach of individuals and small companies. During the late 1920s, Congress authorized extensive surveys of the region's waterways, compiling information on

stream flows, topography, hydrography, irrigable lands, and flood-prone areas. These surveys led to a comprehensive plan for developing the Columbia Basin's water resources. Beginning with Bonneville Dam, completed in 1938, the large multipurpose projects in this region created jobs and the promise of future development. Dams provided flood control and improvements in navigation, along with irrigation for farmers cultivating the arid lands east of the Cascade Mountains.

The most important advantage provided by the dams was considered to be inexpensive power. Despite impending electrical rate hikes in 2001, the region's residents still enjoy the lowest rates in the nation. This trend began with the construction of multipurpose dams in the Columbia River Basin. Inexpensive public power brought electricity to thousands of people, while also attracting industries to the region. For example, aluminum businesses were established in the 1940s on the shores of the Columbia River, and the Boeing Company in Seattle looked to this industry for materials to build its planes. Historically, the Pacific Northwest had depended on logging, mining, farming, and fishing; however, the availability of inexpensive power diversified and expanded the region's economy. Without the dams along the Columbia and Snake Rivers, many residents would not live in this area today (Schwantes, 1996).

Many 20th-century Americans welcomed this development, regarding it as an advancement of civilization. Folk singer Woodie Guthrie, hired by the BPA, applauded the Federal construction of large dams on the Columbia, equating electricity with progress. He depicted the Columbia River dams as a metaphor for progress, a force that would turn "darkness to dawn." Before the dams, he explained, "all this here water" was "just a going to waste." To his mind, the Columbia "needs a couple more dozen big power dams scattered up and down it…keeping folks busy." Guthrie spoke for a generation of Americans awed by the size and complexity of the Columbia River dams, Grand Coulee in particular. This structure, according to Guthrie, "makes the Tower of Babel a plaything for a kid" (Dietrich, 1995). Guthrie's songs did not focus on the salmon runs that Grand Coulee blocked, or on the tribal and commercial fishers that relied on them.

The national conservation movement, which emerged during the late 19th and early 20th centuries, shared his view. Support for irrigation projects had been firmly rooted in the West since the early 20th century, with the passage of the Newlands Act in 1902 and the establishment of a Reclamation Service, which early conservationists promoted. They were concerned that the nation's resources be used wisely and efficiently. Rivers, they believed, should be controlled to produce the maximum benefit to humans. Conservation in the early 20th century focused on eliminating waste, not on protecting habitat. This attitude was reflected in a report that Congress considered in 1913, revealingly titled "Conservation of Natural Resources: An Article on the Waste of our Natural Resources Due to the Nondevelopment of our Water Powers."

By the 1920s and 1930s, this support had extended to generation of hydropower. Conservationists viewed the hydropower generation as an efficient use of water resources. Dams were in fact regarded as "conservation accomplishments." *Bird-Lore*, a national journal published by the Audubon Society, claimed in 1937 that Pacific Northwest residents "are eager for a larger population and more industries" (*Bird-Lore,* 1937).

During the 1930s, relatively few people objected to the construction of hydroelectric dams in the Columbia Basin. Some Americans disapproved of public power, condemning it as a socialist concept. The expense of reclamation projects in the remote West also drew protests. Fisheries scientists were among the most vehement objectors to large multipurpose projects. Worried that the

dams would obstruct the migrations of salmon, the American Fisheries Society passed a resolution against high dams in 1941. Native Americans and commercial fishers also feared that the construction of large multipurpose projects would destroy salmon runs (Palmer, 1991).

While some Americans dismissed these protests as doomsaying, the Federal government did incorporate fisheries management and protection of salmon into water resources development work. In its attempt to accommodate a myriad of interests, Congress concluded that the nation could have dams and fish, too. As *The Oregonian* reported during the 1940s, Federal officials remained convinced that "you can have both dams and salmon" (*The Oregonian,* 1945 and 1947). This perception persisted into the late 20th century, when a Washington State Department of Ecology official assured readers of *The Seattle Times* that the nation can produce power "while still assuring the reasonable maintenance of fisheries resources" (*The Seattle Times,* 1971).

To ensure the continuation of salmon runs, the Federal government funded research and construction of fish passage facilities on the lower Columbia and Snake Rivers. From the beginning of its construction of large multipurpose dams on the Columbia River, the Corps recognized the need to improve fish passage facilities. Beginning with Bonneville Dam in the 1930s, fisheries scientists worked with engineers to refine these facilities. The first challenge that they faced was the lack of information on fish passage. The Baker River Project in the North Cascades, constructed in the mid-1920s, had been one of the projects to confront this issue. "There is no precedent of a problem as it exists at Baker in handling fish," explained one official of the Puget Sound Power & Light Company in 1929, "so it has been a matter of cut-and-try." Fisheries scientists and engineers would also use the "cut-and-try" approach in the Columbia River Basin for the next several decades (Mighetto, 2000).

The fish collection and bypass system at Bonneville included three reinforced concrete fish ladders and two pairs of fish lifts. The fish ladders resembled a stairway of 40-foot-wide compartments, each one foot higher than the last. Engineers built one ladder at each end of the spillway dam and one at the north end of the powerhouse, enabling the fish to ascend 70 feet to the pool behind the dam. The Corps placed lifts at the north end of the spillway dam and at the south end of the powerhouse. These structures operated on the principle of a navigation lock and were designed to accommodate 30,000 fish per day. Also noteworthy was the dam's fish collection system. Fisheries experts recommended that the Corps construct a collection system that included "extensive and varied" entrances supplied with constant water velocity at a high volume. During the first 30 years of operation, an average of one million fish annually passed through this system. Its cost reached nearly $7 million, representing approximately 15 percent of the project cost (Mighetto and Ebel, 1994).

An article in *Colliers* pronounced the fishways at Bonneville "the most unique stairways and elevators of all time." Similarly, *Scientific American* described the construction of fishways as a pioneering effort. This "immense experiment," the journal reported in 1938, "is undoubtedly the greatest thing of its kind reared anywhere up to date. The success of these fishways is a matter of world-wide interest." Initially, the fish passage system at Bonneville appeared so successful that it served as a model for subsequent dams on the Columbia and Snake Rivers. Promoters of further dam development pointed to the success of the Bonneville fish passage system to demonstrate that dams and salmon could co-exist. In 1938, Willis H. Rich, Director of Research for the Fish Commission, pronounced the operation of the ladders "entirely successful" (Mighetto and Ebel, 1994).

Early fish passage facilities focused on assisting adult salmon migrating upstream. Later studies at Bonneville and other dams, however, revealed a mortality rate of at least 15 percent for downstream migrating juvenile salmon at each dam. From 1938 to 1975, the Corps and public and private utility companies constructed 15 additional dams on the Columbia and Snake Rivers. During these decades, it became apparent that adult fish passage structures would not be sufficient to offset the effects of hydroelectric development in the Columbia River Basin. Fisheries managers devoted increasing energy to researching and constructing facilities to augment the survival rate of juvenile salmon.

Public perceptions of hydroelectric development changed considerably during these decades as well. When Congress authorized the Snake River dams in 1945, many Americans viewed hydropower and improved navigation along the Snake River as vital to national defense. Opposition to the dams appeared almost immediately as fisheries experts, tribal fishers, sportfishermen, and commercial fishermen worried that additional development in the Columbia River Basin would further deplete salmon runs. For 10 years, these groups fought the dams, testifying at public hearings about the need for more fisheries research and improvements in fish passage. The Federal government, balancing a variety of interests, continued to support dams, while also making certain that they included fish passage facilities. The Interior Department summarized the Federal position in 1947 as follows: "the Government's efforts should be directed toward ameliorating the impact of this development upon the injured interests and not toward a vain attempt to hold still the hands of the clock" (Petersen and Reed, 1992).

Accordingly, construction of the dams proceeded, with Ice Harbor Dam completed in 1961. President Lyndon B. Johnson dedicated this structure on May 10, 1962 and his words revealed continued support for the dams and what they represented. "All great civilizations have drawn their strength from the valleys of great rivers," he told the crowd. "While America reaches toward the stars, while our aspirations and achievements alike soar to new heights...let us never cease to build in these valleys" (*The Oregonian,* 1962). The completion of Ice Harbor Dam was followed by Lower Monumental Dam in 1969, Little Goose Dam in 1970, and Lower Granite Dam in 1975 (Peterson and Reed, 1992).

These projects included some of the most technically sophisticated fish passage systems in the world. Even so, salmon, particularly juvenile fish, were impaired by this construction. They were injured passing the turbines, their migrations slowed, and they became more vulnerable to predators behind the dams. The problem of gas supersaturation at spillways was particularly serious, resulting in fish kills during the early 1970s, which were widely reported by media throughout the Pacific Northwest and the nation. The *Walla Walla Union Bulletin*, for example, described a legislative hearing in Spokane in 1971. "Don't you think your dam building is going to kill these fish?" asked one state senator of the Corps. In response, Gordon Fernald, Chief Engineer for the North Pacific Division, assured him that the nitrogen problem "is of great concern to us and has our No. 1 priority" (*Walla Walla Union Bulletin,* 1971).

The environmental movement of the 1970s helped fuel public concern about the negative affects of dams on salmon. This decade witnessed a profound transformation in values and attitudes toward the natural world. While early conservationists had focused on the need to use natural resources wisely, encouraging technological solutions, the new movement sprang from a growing awareness of the importance of biodiversity and ecosystems and preferred "natural," non-structural solutions. This increasing environmental awareness, set against the historical backdrop of the push for and benefits of progress, set the stage for the current public debate over hydroelectric dams.

2.2 Habitat

"Garbage was always a problem around the cannery and the mess house… All the garbage from the mess house was tossed over the fence into the creek… If anyone asked what to do with any kind of debris, he was told to just throw it into the creek. Twice a year the creek in flood or high water from the Columbia would sweep away all the debris."

—Francis Seufert

As a cause of salmon decline, "habitat" is especially complex in terms of historical attitudes and practices. "Habitat" is a modern concept; newspapers and other popular publications rarely used the term until the 1960s and 1970s. During the 19th century, settlers in the Columbia River Basin did not view their surroundings as a "habitat" or as an ecosystem. Many Euroamericans perceived natural resources, including salmon and timber, as disparate commodities to be harvested and used. Moreover, changes to habitat were sometimes incremental and difficult to detect. When advocates for salmon searched for causes of the decline of the region's fisheries, they tended to focus on visible, easily identified causes such as harvests and dams.

In the course of their life cycle, salmon utilize a wide variety of aquatic systems including rivers, streams, wetlands, estuaries, and the open sea. Over the course of the last several centuries, human activities have disturbed and altered large portions of this habitat. Mining, logging, farming, grazing, urbanization, and industrial pollution have all taken their toll on aquatic habitat used by salmon populations in the Columbia and Snake Rivers. The building of dams has also eliminated a good deal of salmon habitat. While each of these endeavors has a long history, their pace and intensity increased dramatically over the past 100 years, contributing significantly to the ESA listing several species of Columbia and Snake River salmon.

2.2.1 Mining

Mining, which had become a significant industry by the mid-19th century, affected salmon habitat in a variety of ways. As biologist Henry Ward noted, this activity amounted to a "violent overturning of natural soil" (Taylor, 1999). Many mining operations occurred a few feet from the water, and detritus washed into streams, smothering spawning beds. Soil was not the only thing washing into the streams; gold and coal mining caused acidic chemicals to leach into streams, altering their chemical balance. Large-scale industrial mining in the Columbia Basin produced large piles of tailings that in subsequent decades would release heavy metals, especially lead, into tributary streams (Robbins, 1996; Netboy, 1980; Dietrich, 1995).

Mining also relied on a series of mechanical operations that caused additional harm to streams. Diversion dams rarely included fishways, and both juvenile and adult salmon were drawn into ditches and blown through nozzles. Salmon that remained in the stream often experienced decreased water levels in the summer months. This drop in water often contributed to a rise in water temperature, threatening salmon further. Miners also used wing dams to divert streams temporarily and some streams were blocked entirely. By the end of the 19th century, miners also began using dredges to root through streambeds at a faster and more destructive pace (Taylor, 1999).

Placer mining for gold was particularly destructive. This process, in which the stream's gravel was washed to find gold, destroyed spawning and rearing areas, tore up the stream bed, and flushed silt and debris into the stream. Not only did it damage salmon habitat, it also contributed to a decline in water quality. Many observers recognized the negative impact of mining on salmon habitat. In fact, as early as 1894, the U.S. Fish Commission reported that placer mining near Caldwell, Idaho had significantly reduced salmon runs on the upper Boise River (Gilbert and Evermann, 1894). By the 1940s, large sections of the Burnt, Grande Ronde, and Clearwater Rivers were judged "unsuitable for salmon" (Taylor, 1999). Despite this recognition, many forms of mining continue today in the Columbia Basin and throughout the Pacific Northwest.

2.2.2 Logging

Logging, which grew to be one of the most important industries in the Pacific Northwest, also affected salmon habitat in numerous ways. Logging was relatively small and localized in the Columbia Basin until 1894, when the new railroads cut shipping rates to spur business. By 1909 there were 300 lumber mills in the mountains that fringe the Columbia Plateau, and logging volumes in northern Idaho had increased 14 times over (Dietrich, 1995).

In the early days of the timber industry, loggers cut primarily along riparian areas and nearby hillsides. They also relied on the network of waterways to float their timber to the mills and markets that lay downstream. This activity reduced streamside cover, destabilized stream banks, and increased sediment loads. Dragging large trees up and down steep slopes to yarding sites, or directly into the river, disturbed soils, contributing to increased surface erosion. Once the trees reached the water's edge, logs often jammed in streams, sometimes preventing salmon passage. In an attempt to regulate streamflow and avoid these types of jams, loggers constructed splash dams along many of the area's rivers. These dams allowed loggers to retain water and then flush logs downstream on a precise schedule. The dams also helped extend operations into the dry season.

Loggers began using splash dams in coastal streams as early as 1870, and the practice continued in some places through the 1930s (Taylor, 1999). These structures caused serious problems for salmon. Many of them completely blocked the stream or river, and very few included effective fishways. Splash dams also caused the water flow to fluctuate wildly. When the dam gates were closed, streams dried up. Once the dams were opened, the stream was flooded in a torrent of churning water. This sudden rush of water and logs scoured spawning beds and rechanneled streams, harming salmon, eggs, and juveniles caught in the flood. Huge releases of water also eroded riverbanks, widened streambeds, and buried the deep pools salmon needed for migration and rearing (Taylor, 1999).

While cutting along riparian areas was the easiest method for early loggers, eventually these areas were depleted and logging moved upslope into the interior timber stands. The pace of logging quickened in the first half of the 20th century. The advent of railroads and, later, logging trucks and road networks, aided the process of transporting these logs to market, and removed some of the industry's reliance on waterways. The introduction of steam power to logging operations, especially in the form of the steam donkey, increased the efficiency harvest. High-lead yarding, saw blades, and chain saws, were also introduced during this period. These changes allowed the industry to cut deeper and faster into forests, exacerbating problems with erosion, siltation, and logjams (Robbins, 1996; Taylor, 1999).

2.2.3 Agriculture

In addition to mining and logging, the development of agriculture over the past century affected numerous streams in the Columbia River Basin. Farming, which was an integral component of pioneer life in the region, accelerated considerably with the advent of railroads, and the new markets they promised. By the late 19th century, the trade in agricultural goods was booming, and crops such as wheat stretched across the Columbia River Basin.

Historical farming practices affected salmon habitat in many ways. Plowing, for example, released large amounts of sediments into nearby rivers and streams, making fish migration more difficult and reducing the quality of spawning and rearing areas. The more farmers tilled the soil, the greater the sediment loads became in the streams. By the 1880s, heavy silt loads had become noticeable in the Columbia River Basin. Plowing also released pesticides and fertilizers that were used to control crops (Taylor, 1999). In addition, the use of herbicides and pesticides has been raised as a potential impact that has contributed to the decline of salmon.

Agricultural practices in coastal areas also affected habitat. Farmers in estuarine communities diked and dredged hundreds of acres of wetlands in order to plant their crops and graze their livestock. Wetlands, however, were "the grocery store of the wild," providing crucial feeding grounds for salmon as they made their journey from inland streams to the ocean (Dietrich, 1995). Without this chance to feed, salmon entered the Pacific poorly nourished and less equipped for their ocean migration. Today, in the lowest 46 miles of the Columbia, only 23 percent of tidal swamps and 35 percent of marsh swamps remain (Dietrich, 1995).

Farming in the arid areas of the Pacific Northwest further altered the region's land and water resources. Beginning in the 19th century, many farmers in the Columbia River Basin transformed arid lands through irrigation. Commercial irrigation began in the 1860s and 1870s, providing opportunities to farm more areas east of the Cascades. The arrival of railroads boosted irrigation attempts as farmers attempted to increase production lured by the possibility of new foreign and domestic markets (Taylor, 1999).

Increased irrigation, however, meant a decrease in salmon. The most obvious effect of irrigation was the diversion of water from streams. This often occurred when water was needed for upstream or downstream migrations, and, in many cases, entire streams were left completely dry. The building of diversion canals and small dams for agricultural production further hindered the migration of salmon. The canals, many of which were left unscreened, stranded salmon on farm fields, where they died (Mighetto and Ebel, 1994; Netboy, 1980; Taylor, 1999). Today, there are more than 900 irrigation intake structures in Washington, Oregon, and Idaho; only in recent years has there been a systematic effort to get them screened. There is no maintenance program, however, to keep them that way (Dietrich, 1995). Small dams for irrigation led to further problems. Most farmers used simple gravity systems with headgates, but some employed low dams to divert water. While a few of these dams extended only partly into the current, most spanned entire streams and none had fishways. During high water fish could pass these barriers, but in periods of low water, fish passage was prevented (Taylor, 1999).

Early settlers were aware of the potentially destructive nature of these small dams. In 1848, the constitution for Oregon Territory declared that rivers and streams important for anadromous fish "shall not be obstructed by dams or otherwise, unless such dams or obstructions are so constructed as to allow salmon to pass freely up and down such rivers and streams." In 1894 Hugh M. Smith of

the U.S. Fish Commission argued that one dam on the Clackamas River in Oregon "is generally recognized as one of the greatest evils now affecting the fisheries of the Columbia River Basin" (Mighetto and Ebel, 1994). Despite their concern, many dams continued to block fish passage and destroy habitat.

The agricultural industry's effect on the land was not limited to the planting of crops and the procurement of water. Many ranchers grazed sheep, goats, and cattle. Dairy herds predominated in the wetter climates of western Oregon, while cattle and sheep dominated the plateau. As they foraged for food and water, livestock altered streamside vegetation, affecting salmon habitat. Away from the streams, they destroyed ground cover. Runoff increased in winter and spring, causing downcutting of riverbeds and banks, but then dropped dangerously low in the summer, leaving some spawning beds dry. Near the streams, livestock stripped protective vegetative cover from the banks, crumbled dirt into the rivers, and defecated in the water. As historian Joseph Taylor noted, "Cattle demonstrated a particular talent for turning streams into bovine toilets" (Taylor, 1999).

2.2.4 Industrialization

The impact of mining, logging, farming, and grazing on salmon habitat was compounded by industrial pollution that flowed into the Columbia and its tributaries. Untreated industrial wastes together with urban sewage severely degraded water quality and breeding habitat. Pollutants and urban sewage became especially serious in the post World War II era, when industrial activity expanded and the population grew. Pulp and paper mills, many of which were located along the Willamette River in Oregon, poured enormous quantities of wood chips and chemicals into the river, as well as released fumes into the air. Drawn to a waterfront location, other industries, such as canneries and smelters, joined the pulp and paper manufacturers on the Columbia and its tributaries (Netboy, 1980; Robbins, 1996). Describing the dumping practices of a salmon cannery, cannery owner Francis Seufert recalled that, "All garbage from the mess house was tossed over the fence into the creek." He continued, "If anyone asked what to do with any kind of debris, he was told to just throw it into the creek. Twice a year the creek in flood or high water from the Columbia would sweep away all the debris" (Dietrich, 1995). Mine tailings also contributed to the chemicals that leached into the region's waterways.

In addition to industrial pollutants, rivers and streams in the Columbia watershed became affected by urban and rural communities' practice of releasing untreated sewage directly into open waters. As the region's population expanded, the problem of urban sewage became more ominous. Near Portland, the Willamette River became so polluted that during the summer there was not enough oxygen to support fish life. "Even crawfish crawled out of the water to get some air," remarked one observer (Netboy, 1980). Communities along the lower Columbia also treated it as an open sewer, much to the dismay of gillnetters who often found their nets "shrouded with slime" (Netboy, 1980).

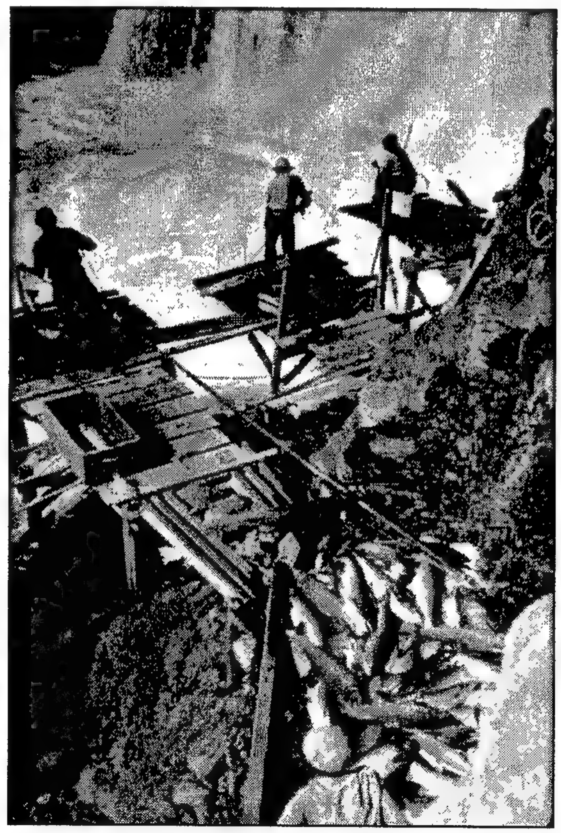
These activities did not go unnoticed. As early as 1933, for example, the Oregon State Game Commission stated that "there is no question but that the pollution of the tributaries of the Columbia is a menace to the salmon industry" (Mighetto and Ebel, 1994). In 1942, the National Resources Planning Board warned that the "pollution of waters in a number of areas of the Pacific Northwest [is] a growing menace quite generally, the cities and industrial plants discharge raw sewage into streams" (Dietrich, 1995). Today, while public outcry and government regulations have resulted in the treatment of certain industrial wastes, many chemicals continue to enter the Columbia and its tributaries, threatening salmon and other aquatic life.

2.3 Harvests

"It was clear that too many fishermen were chasing too few fish."
Anthony Netboy, *The Columbia River Salmon and Steelhead Trout*, 1980.

2.3.1 Early Tribal Fishing

The rivers and streams of the Pacific Northwest were once thick with migrating salmon. Early visitors marveled at the spectacle, calling it "one of the striking wonders of the region" (Brown, 1982). In the mid-19th century, salmon were viewed as an inexhaustible resource. The bounty of nature in the Pacific Northwest quickly became legendary, and many accounts by Euroamerican observers suggested that this resource could last forever, much like the ancient forests that stretched across the Northwest or the buffalo that inhabited the Great Plains. So abundant were the salmon runs that one English visitor wrote that, "the number of fish who reached these beds was so great the receding waters would leave millions of dead salmon strewn along the banks, emitting a stench that could be smelled miles off, and which never failed to attract a great number of bears." He continued, "Though I have never performed the feat of walking across a stream on the backs of fish, which many an old timer will swear he has done, I have certainly seen fish so numerous near their spawning grounds that nowhere could you have thrown a stone into the water without hitting a salmon." Confronted with an astonishing number of spawned out and dying salmon as he searched for a spot to beach his boat, artist Paul Kane similarly observed, "I have been obliged to travel through a while at night trying to find an encampment which would be free from their disgusting effluvia" (Dietrich, 1995).



Native American Dipnet Fishery Site at Celilio Falls

Native Americans had long relied on Columbia River Salmon. Anthony Netboy, who wrote extensively on salmon issues in the mid-20th century, argued that the "cycle of salmon and other anadromous fish appearing and disappearing from the rivers ruled the rhythm of Indian life, for without a fish supply they were in danger of starving." To maximize their catch, Indians tended to concentrate their fishing at natural barriers, such as waterfalls, which held up migratory fish. At these sites, Native peoples erected platforms from which they used dipnets to capture fish. Salmon were also caught in bays and sloughs with spears, harpoons, dipnets, hook and line, and, on a larger scale, with seines, traps, and weirs. Indians sometimes fished from canoes, using bone hooks and lines to which smelt were attached as bait. Salmon, sturgeon, and other large fish could be stabbed with a gig or a spear. On a communal level, Indians commonly erected weirs, which were constructed of brush and saplings and supported by willow stakes to which baskets were attached. These structures were most successful in narrow channels (Netboy, 1980).

Indian dipnet sites were more than simply a place to catch fish. They were also intimately known and personal spaces. Tommy Thompson, the 80-year-old leader of Celilio Village wrote in 1945, "All these usual custom fishing places and rocks have names and I know all of them." These sites were repositories of individual and tribal memory, places where generations had come together to celebrate the arrival of the salmon, and, as such, they were valued possessions. The Bonneville Dam destroyed the Indian dipnet fishery at the Cascades in the late 1930s, Grand Coulee drowned the one at Kettle Falls in the early 1940s, and the Dalles Dam flooded the last remaining Columbia dipnet fishery at Celilio Falls in 1956 (White, 1995).

2.3.2 Early Commercial Fishing

While Indians were the first people to utilize the salmon of the Columbia River, the abundance of this fish soon attracted others. The earliest commercial ventures on the river were the canneries, which were established in the mid-19th century along the Pacific Coast. William Hume at Eagle Cliff established the first cannery on the Columbia in 1866. In its first year of operation, the cannery released a pack of 6,000 cases of 48 cans each, for a total value of $64,000 (Schwantes, 1996). From its inception as a single factory, canning quickly became a full-fledged industry on the Columbia River. By 1873, there were eight canneries, and 10 years later there were 39. The period from 1883 to 1887 marked the peak in the number of canneries on the Columbia; shortly thereafter, the number of factories dropped off rapidly. By 1890 there were 21, and by 1935 only 10 canneries were left (Craig and Hacker, 1940).

For a brief period, however, the industry boomed. One reason for the rapid development of canning was that it was "an entirely new industry with an apparently inexhaustible supply of the raw materials ready at hand and easily obtained" (Craig and Hacker, 1940). Chinook salmon, which sometimes weighed more than 100 pounds and were referred to as "June hogs," were one of the most popular "raw materials" for cannery owners. One cannery owner was particularly impressed with this fish. "Because of their size, when you packed them into cans, only one slice of salmon was necessary to fill the can. When the customer purchased this can of Royal Chinook salmon and took it home and emptied it, he found just one nice chunk of salmon the size of the can, rich in oil, fine color, excellent texture, and superb flavor." He concluded that, "This salmon really deserved to be called Royal Chinook. It had no peer in the canned salmon markets of the world" (Dietrich, 1995).

In addition to the abundant supply of fish, the industry was also aided by good prices and quick profits from moderate investments (Craig and Hacker, 1940). Canned salmon was popular in both the United States and abroad as inexpensive, nourishing working-class food (Schwantes, 1996). During the early years of the industry, the principal markets were South America, China, and the Hawaiian Islands. California also received a good deal of canned salmon from the Columbia River. By 1874, limited shipments of canned salmon were being sent to New York, St. Louis, Chicago, Memphis, and New Orleans. The domestic market expanded with the construction of railroads, which linked the Pacific Coast to the eastern United States and Europe (Craig and Hacker, 1940).

Given its auspicious start, it is perhaps surprising how quickly this industry declined. Part of the reason was that, as the number of plants exploded and production increased, prices began to drop. Competition from cheaper fish, such as steelhead and salmon from other districts, also lowered prices. In addition, as the number of establishments grew, the canneries competed with one another for fish, raising the price they paid to the fishermen for the salmon. In 1878, canners paid fishermen $0.25 per chinook, by 1890 that price had increased to $1.00. During this same period, many

packers also began to note that chinook runs were not as abundant as they once had been, and, fearing a shortage of fish, many left the business (Craig and Hacker, 1940). By the turn of the century, the canning industry was no longer centered on the Columbia River, as it expanded to Puget Sound and Alaska (Schwantes, 1996).

Commercial fishing ventures blossomed with the advent of the canning industry on the Columbia River. While chinook were the most popular fish among the canners, commercial anglers also caught coho, chum, and sockeye salmon. Another anadromous fish, steelhead trout, was also popular, and the Columbia River was in fact the principal steelhead stream on the Pacific Coast. In addition to migrating species, commercial fishermen also harvested shad, smelt, sturgeon, and crayfish from the Columbia River (Craig and Hacker, 1940).

Numerous methods were used to catch fish, both on the Columbia and its tributaries as well as on the open ocean. Some of the more widely used devices included gillnets, seines, diver nets, traps, pound nets, and fishwheels. Each of these methods was suited to specific places along a waterway, and each was uniquely constructed to ensnare unsuspecting fish.

Gillnets were favored in salmon harvesting along the Pacific Coast. Originally they were constructed of flax or linen twine, later replaced by nylon. These devices were hung along a rope with cork floats to support the upper portion of the net, while a line with lead sinkers kept the net vertical in the water. Often used in estuaries and rivers, their size varied depending on the depth of the water and the width of the fishing channel. When fish encountered a net, they were able to penetrate it partially, but as they tried to remove themselves their gills became entangled. The size of the opening varied, depending on the type of fish sought. Gillnets provided a highly efficient method of fishing, allowing smaller fish to swim unimpeded through the openings. When stretched across a river of migrating salmon, the net became heavy with entrapped fish in a matter of a few hours or even minutes (Cobb, 1930; Craig and Hacker, 1940; Roberge, 1985).

A number of types of seines were used on the Pacific Coast. Haul seines, for example, were prominent on the Columbia River. Haul seining occurred on sand bars at low tide. The net would be placed in a large seine boat that would circle around against the current until the net was paid out in the shape of a semicircle. There, a team of horses was hitched to it and would begin the process of hauling in the net (Cobb, 1930). Purse seines, which were used mostly in Puget Sound and southeast Alaska, were an effective technique for harvesting in deep waters. These large nets, which hung vertically in the water, were designed to be set between two boats surrounding a school of fish. They sometimes measured 3,000 feet in length and could reach depths of 80 feet. Purse seining was greatly aided in the early 20th century by the replacement of hand-powered vessels with motorboats. In 1934, 57 seines operated on the Columbia River, 33 on the Oregon side, and 24 on the Washington side (Craig and Hacker, 1940). These devices could catch tremendous numbers of fish. One seine, operated by the Seufert Brothers Company near Celilio Falls, harvested 70,000 pounds of fish on a single day in 1947 (Mighetto and Ebel, 1994).

Diver nets were used on the Columbia River, mainly on the upper and middle portions. These were used almost exclusively for chinook and consisted of two nets attached side by side. The outer one, which faced the oncoming fish, was of a larger mesh than the inner one. This helped ensure that if a fish was able to pass through the first net, it would be caught in the smaller openings of the second net (Cobb, 1930).

Fish traps or pound nets were also useful to fishermen on the Columbia River. These were stationary devices consisting of mesh webbing strung between posts driven into the river bottom. By featuring a lead, which guided salmon through a series of smaller and smaller openings until the fish were caught in a net, fish traps exploited salmon's tendency to swim upstream. Placed at the mouth of a river, these devices required little effort and could catch a considerable number of fish. By the late 1920s, fishers had more than 400 traps in the Columbia River region (Mighetto and Ebel, 1994).

Fish wheels first appeared on the Columbia in 1879. By the 20th century, there were approximately 79 of these devices operating along the river. Essentially large wooden water wheels, these structures were built over rocky channels where migrating salmon tended to swim. As the current turned the wheel, a wooden bucket on the downstream side of the paddle would scoop up salmon, lift them clear of the river, and dump them into a deep wooden box. While the wheels only took about 5 percent of the Columbia salmon harvest, historian William Dietrich argued that "their looming presence and the inexorable turn of their wheel seemed like an irritating reminder of the insatiable and shortsighted greed that ruled the fishing industry." Eventually the wheels were banned in Oregon in 1926 and Washington in 1934 (Dietrich, 1995).

Devices such as the fish wheel and purse seine took their toll on salmon populations. Chinook, which was the most sought after of the salmon species, was the first to show signs of decline. The number of chinook salmon peaked in the 1880s, and as early as 1894, the Oregon Fish and Game Protector warned that chinook populations were "threatened with annihilation." As the number of chinook fell, fishermen moved on to other species, such as coho and sockeye. These fish were also marked by a "pronounced fall" by the early 1920s (Mighetto and Ebel, 1994). The decline was truly staggering. In 1911, 46 million pounds of canned Columbia salmon were produced. In 1938, the year the Bonneville Dam was completed, the annual catch of salmon had slumped to 20 million pounds (Dietrich, 1995).

Concern for the deteriorating fishing industry sparked a series of conservation measures. While other factors, such as habitat decline surely contributed to the demise of salmon runs, overfishing was an obvious culprit and an easy target for conservationists. These early attempts were, however, sporadic and largely ineffective. As early as 1877, the legislature of Washington established a closed season; Oregon followed quickly with similar measures. State governments also banned the use of certain types of fishing gear on the Columbia River. For example, during the late 19th century, Oregon and Washington prohibited fish traps, weirs, and seines. Purse seines were prohibited on the Columbia in 1917 and by 1922 they were also banned in the coastal waters off Oregon and Washington. As noted previously, fishwheels had been banned in 1926 and 1934. Although both Oregon and Washington created fish commissions in the 1880s and 1890s, neither organization had sufficient funds to police the river and catch offenders. Thus, these early restrictions did little to halt declining salmon runs (Mighetto and Ebel, 1994).

Economic concerns promoted these early conservation measures. In the 1930s, W.H. Rich, Director of Research for the Oregon Fish Commissioner, argued that salmon were worthy of "consideration far beyond their immediate economic value." His pleas were largely ignored, and the fishery issue continued to be framed as a technical problem in a largely economic enterprise. Managers, canners, and commercial fishermen defined salmon as "capital," regarding these fish as a commodity, similar to lumber or wheat (White, 1995). In this era, when many managers and policy makers unquestioningly placed their faith in the ability of science and technology to protect natural

resources, the hope was that the "resource [salmon] can be preserved if proper planning and conservation measures are followed" (Craig and Hacker, 1940).

During the late 19th and early 20th centuries, concern about sustaining the salmon runs was related to anxiety about extensive harvests of other resources, including timber. Some Americans at this time viewed the widespread, unrestricted logging in western Washington with alarm, fearing that the timber would be depleted. This desire to protect the country's natural resources from unregulated use resulted in the formation of a nationwide conservation movement. Advocates promoted establishment of forest reserves (later called national forests) such as the area set aside around Mount Baker in 1897. These were public lands that the Federal government managed.

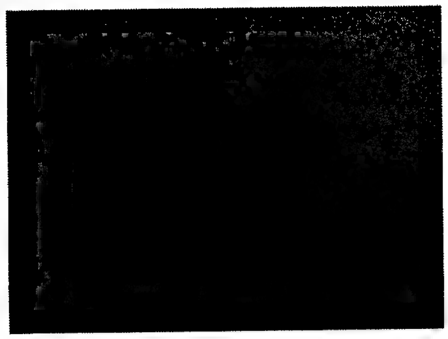
Conservationists also called for protection of fish and wildlife, which they viewed as public resources. Late 19th-century Americans had witnessed harvests of unprecedented proportions. Many attributed the rapid decline of the buffalo and passenger pigeon to hunting for profit. These species were once so abundant that they seemed inexhaustible. By the 1870s and 1880s, however, the buffalo had become nearly extinct, and the last passenger pigeon, a prolific species whose extensive flocks had once darkened the skies of the Midwest and the eastern United States, died in the Cincinnati zoo in 1914 (Reiger, 1986).

During this era, some observers feared that the salmon were headed for a similar fate. Encouraged by conservationists, Federal and state governments created fisheries agencies during the late 19th and early 20th centuries to ensure perpetuation of fish populations—particularly those with high values for commercial and sport catches. Although habitat degradation also led to fish loss, it was sometimes more difficult to detect and less immediately visible than salmon harvesting. Accordingly, early efforts to protect salmon and steelhead focused on managing harvests rather than protecting habitat. The objective was to decrease the number of fish taken by implementing regulations.

Despite their belief in the powers of science and technology, early conservationists were hampered by a lack of understanding of the river conditions and habitat requirements of anadromous fish. Also, there was little knowledge about the actual migration cycle of salmon. In 1888, the Corps reported that "almost nothing" was known about where the salmon travel, "how they fare, or what motives guide their course in their mysterious ocean sojourns." In the 20th century, planners continually complained about the "meager and fragmentary data" available on the habits of fish, and in 1909 the Bureau of Fisheries remarked that this topic was "shrouded in obscurity" (Mighetto and Ebel, 1994).

2.3.3 Early Sport Fishing

As scientists and managers directed their conservation efforts towards the commercial fishing industry, they largely overlooked another important group who also harvested Columbia River salmon—recreational anglers. During the late 19th century, the Columbia River became world renowned for recreational fishing. Like the canners, sportfishermen were especially interested in chinook, which afforded the "best sport." Sockeye and steelhead were also popular catches. Anglers estimated the worth of a species based on its "character," which was comprised of its preference of bait, fighting ability, and taste. "Those that passed muster were lionized," according to historian Joseph Taylor, while "those that failed were labeled 'coarse' or 'rough.'" (Taylor, 1999).



To catch any manner of fish, anglers used a variety of baits. Visiting sportsmen from the east preferred to use flies to catch the prized chinook, while local anglers used salmon roe and spoons or fishing lures. These were spoon-shaped devices with a treble barbed hook that could cause serious injury to the fish when removed. Each group debated about the merits of its favored technique.

Early limits on the catching of salmon for personal use were liberal. In 1922, an attempt in Washington to restrict the catch to 3 salmon, 18 inches or greater in length, was so poorly received by anglers that within the year the limit was increased to 25 salmon, 10 inches or more in length. While catch limits were unpopular among many sportfishermen, early sports fishing organizations in Oregon and Washington did attempt to implement protective measures. One of the earliest was the Steelhead Trout Club of Washington, which was formed in 1928 to monitor catches of net-scarred fish (nets had become illegal by this time) and encourage greater protection of steelhead. The Washington State Game and Fish Protective Association advocated the implementation of uniform game laws, including bag limits. In Oregon, the Sportsman's League was established in 1913 to serve as a clearinghouse organization for state sport groups. In 1919, the League submitted two initiatives to the public, one that would create a separate game commission and the other that would establish local control over fish propagation and the taking of fish from streams (Mighetto and Ebel, 1994).

2.3.4 Tribal Fishing in Modern Era

As the number of anglers on the Columbia River increased, the number of fish declined. While it was easy to blame fishers for this decrease in salmon, harvests were only one factor contributing to the rapidly vanishing fisheries. Habitat loss and degradation, coupled with the rise of multipurpose dams, also took a heavy toll on salmon populations. Nevertheless, overharvesting remained a problem, and increased pressure on the resource led to increased conflict among user groups.

Tension between Native American fishers and other users of the Columbia River was not a new phenomenon, but rather dates back to the 1850s. During the 20th century, however, conflicts escalated as tribes asserted their rights to continue fishing, at times turning to the courts. One of the earliest litigation cases, involving Indian fishers in the Northwest was in 1905 and addressed the question of access to off-reservation fishing sites. In *U.S. v. Winans,* the U.S. Supreme Court ruled

that the Indians retained the right of access to their "usual and accustomed" fishing places. In 1919, the Court reaffirmed this decision in *Suefert Brothers Company v. U.S.* (Smith, 1979).

The construction of large multipurpose dams along the Columbia River, beginning in the 1930s, prompted further questions about treaty rights, and many Indians protested individual dam projects. In *Tulee v. Washington*, a Federal court recognized in 1942 that prior to negotiation of the treaties, the tribes had established fishing regulations "through custom and tradition." The Federal courts in the 1940s and 1950s suggested that in the interest of conservation the states should also limit the taking of fish; however, the issue was not clarified. Accordingly, throughout the 1960s, Indians in the Northwest argued that the conservation regulations of fisheries agencies were discriminatory in their attempts to limit salmon catches outside the reservation. By the mid 1960s, protests had become militant. To bring the issue to public attention, some Indians organized "fish-ins," which were deliberate attempts to get arrested for catching salmon illegally (Landau, 1980).

Two crucial rulings affecting Indian fishing rights were made in the 1960s and 1970s. The first was *U.S. v. Oregon*, in which a group of Northwest Indians, the Sohappy plaintiffs, argued that their subjection to state fishing regulations violated their 1855 treaty rights. In 1969, Judge Robert Belloni ruled that the state must give Native Americans the opportunity to harvest "a fair and equitable share of fish which the state permits to be taken from any given run." The second case, which unfolded in Washington, addressed the issue of inequitable harvesting and whether Indians were subject to state regulations off the reservation. In this case, Judge George Boldt interpreted the 1855 treaty phrase "in common" to suggest equal sharing among non-Indian and Native American fishers. "In common with," he concluded, "means sharing equally the opportunity to take fish at 'usual and accustomed grounds and stations.'" Treaty Indians were therefore entitled to 50 percent of the harvestable catch not needed for spawning escapement. Shortly after Boldt's ruling, Judge Belloni also adopted the 50 percent allocation for Oregon, and in 1979, the Supreme Court upheld the Boldt decision (Landau, 1980).

These court decisions did not end the debate over Native American fishing. To implement the court decisions in Washington and Oregon, state governments had to increase the Indian harvest of salmon by decreasing the catch of other fishers. Not surprisingly, this was not always well received. Sportfishermen, for example, protested Native Americans capturing steelhead in their nets. Steelhead, which had been declared a game fish in both states, could only be taken with hook and line. To conserve this fish, state agencies also established limits on gear, bag, size, and duration of season. The Indian treaties, however, had not distinguished between food and game fish, and sportsmen resented Boldt's decision to allow Indians to sell steelhead. But for Indians, steelhead were economically as well as culturally significant (Smith, 1979).

By the late 1980s and 1990s, relations between Indians and other anglers had improved. Both

groups had gained a greater recognition of the limitations of the fisheries, and the need to cooperate to find a solution. It had become clear that in-fighting among commercial, sport, and tribal fishermen would not save the salmon.

2.3.5 Commercial and Sport Fishing in Modern Era

During the 20th century, commercial catches of salmon and steelhead on the Columbia River varied. In the late 1930s, they averaged about 18 million pounds annually, which was a substantial drop from the 40 million pounds averaged during World War I and a decline of 50 percent from their 1911 peak. Catches dropped steadily in the post World War II era (Netboy, 1980; White, 1995). During the 1940s, ocean trollers hauled a large percentage of the catch, and advances in technology improved navigational aids, netting materials, and fish-hauling equipment.

Salmon were in fact viewed as an important resource during World War II. "Columbia River chinook salmon is recognized as the best," asserted one U.S. Army bulletin. "It is exceptionally rich in oil and of a delicious flavor. The flesh is very tender." *The Oregonian* further informed its readers in 1945 "weary soldiers have been fortified by Columbia River salmon strips on a piece of hardtack. When they want food with plenty of nutrition, military organizations all the way from the U.S. Army to the Royal Canadian Mounted Police specify Columbia River chinook salmon." Housewives also appreciated this fish, viewing it as a delicacy. "Few...have not sighed over flaky steaks and tempting slabs from the oven, garnished with lemon and browned butter" (*The Oregonian,* 1945).

The 1940s also saw an increase in regulations. The Pacific Marine Fisheries Commission, for example, was established in 1947 to oversee ocean fisheries along the West Coast. This interstate commission reviewed fisheries research data and tried to develop unified positions on regional fisheries issues. In later decades, fishing seasons were shortened and the number of fishing fleets was restricted (Mighetto and Ebel, 1994).

After World War II, population growth as well as increased affluence and leisure time considerably augmented the number of recreational anglers. The interest in sports fishing grew rapidly in the 1960s and 1970s. Almost a million anglers fished for salmon and steelhead in the rivers in 1976 and 1977 in Oregon, Washington, and Idaho. In 1976, their coho catch was 1,720,000, and in 1977, a drought year, it was 900,000. Sportfisherman chinook harvest totaled 631,000 in 1976 and 553,000 in 1977, while the steelhead catch increased from 210,000 to 258,000. Anthony Netboy painted a vivid picture of the scene that must have greeted sportfishermen during this period. "On any summer morning, especially on weekends," he wrote, "in towns [located on both sides of the Columbia], there is a stir and bustle long before the sun rises in the eastern sky. Boats are tied up side by side on the slippery docks...by sunrise the entire fleet is beginning to head for the Columbia bar and soon myriads are converging on the area where the fish are known to be moving. Fishing lines are dangling from the sides or afterdecks, the boats, with their engines stopped, rising and falling with the swells. Over their radios skippers are communicating in staccato tones, telling each other where fish are being caught, and racing their boats and anglers to the spots" (Netboy, 1980).

This activity, like the activities of large multipurpose dams along the Columbia and Snake Rivers, remained highly visible to the public, resulting in calls for additional regulations. In the early 1960s, for example, Oregon imposed a limit of two salmon, 22 inches or more in length for the mouth of the Columbia River. Washington allowed a daily bag of three fish, 20 inches or more. Fish derbies, which were once extremely popular tourist attractions along the Pacific Coast, were prohibited by

the Oregon legislature in this period. In 1970, the sport-fishing season both on the ocean and in the rivers was reduced (Netboy, 1980). The following year, *The Seattle Times* reported the importance of not only protecting the salmon but also ensuring that the various uses, including sport fishing, could continue. "Tens of thousands of salmon and steelhead are caught by sportsmen" in the Columbia River Basin, noted one biologist. "Ask the hundreds of thousands of people who participate or are affected in some way by this activity if it is worth saving" (*The Seattle Times*, 1971).

2.4 Hatcheries

"In my mind, the use of hatcheries is going to continue to be a necessity...There's been too much degradation of habitat for wild runs, particularly in the main Columbia."
Bill Herschberger, Fish Geneticist, University of Washington

In addition to regulating seasons and methods of harvest, early state and Federal authorities turned to hatcheries and fish culture as a means to perpetuate salmon and steelhead populations. During the early 1870s, cannery interests in the Pacific Northwest experimented with artificial propagation of these fish, and for the next century the Oregon Fish Commission, Washington Department of Fisheries and Game, the U.S. Fish Commission, and their successor agencies constructed hatcheries throughout the Columbia River Basin and Puget Sound. Some fisheries authorities placed substantial faith in hatcheries. The U.S. Bureau of Fisheries, for example, claimed in 1913 "the possibilities for fish-cultural work are practically unlimited," particularly "with reference to the Pacific Coast salmon" (U.S. Bureau of Fisheries, 1913). Similarly, fisheries expert John N. Cobb noted in 1917 "the census of opinion is that artificial culture does considerable good" (Cobb, 1917). This faith in hatcheries reflects an early 20th-century belief that science and technology combined could sustain a critical resource, allowing continued use and harvests (Taylor, 1999).

Most of the work in fish culture centered on the Columbia River. The Central Hatchery, established at Bonneville in 1909, was heralded as the largest in the world. By 1937, it had become one of seven hatcheries operated by the State of Oregon. The following year, the Mitchell Act funded state and Federal hatcheries on the lower Columbia River to offset the impacts of Bonneville and Grand Coulee Dams, along with the effects of logging and pollution. This legislation encouraged the establishment of hatcheries in Oregon, Washington, and Idaho (Mighetto and Ebel, 1994).

After World War II, engineers and fisheries managers continued to view hatcheries as the means to ensure continuing salmon runs. In 1976, Congress authorized construction or expansion of 12 hatcheries and 11 satellite facilities in Idaho, Oregon, and Washington at a cost of $177 million. These hatcheries were developed to mitigate the salmon losses resulting from the Snake River dams (U.S. Fish and Wildlife Service, 1990). During the 1960s through the 1980s, they helped increase the total number of salmon on the Columbia and Snake Rivers. Although some fisheries experts were skeptical, many viewed hatcheries as essential for sustaining salmon runs. Bill Herschberger, a fish geneticist at the University of Washington, explained "there's been too much degradation of habitat for wild runs" (Dietrich, 1995).

The region's earlier reliance on hatcheries, however, came under scrutiny during the environmental era. By the 1980s, an increasing number of fisheries biologists had pointed out that reliance on hatcheries had weakened the gene pools of wild stocks. Moreover, large numbers of juveniles released from hatcheries competed with wild salmon for food, space, and cover. Opponents of

artificial propagation argued that wild fish remained genetically better equipped for survival, as hatchery fish are subject to disease and predation (Dietrich, 1995).

This change in thinking reflects a larger theme in fisheries management. Management practices, though based on science, are subject to change as public perceptions shift. During the early 20th century, for example, Cobb had argued that spawning fish should be removed from their streams—an action that was necessary for the operation of hatcheries. Because salmon die after spawning, he explained, natural reproduction left carcasses that clogged waterways, threatening the health of juvenile fish (Cobb, 1917). By the late 20th century, however, biologists had discovered that many wildlife species, including the bald eagle, depended on salmon carcasses. This became an observation that coincided with the weakening of support for hatcheries and artificial propagation. Some biologists now return the salmon carcasses from hatcheries to their streambeds.

Other fisheries management practices have come into question during the last 2 decades. Ideas about the role of large woody debris in stream channels, for instance, have also changed. As noted, early 20th-century logging operations gave little consideration to their effects on fish habitat, often piling logging slash and road construction debris into streambeds. During the 1960s and 1970s, fisheries managers overcompensated for this degradation by clearing streams so thoroughly that they became denuded of large woody debris. By the 1980s, fisheries biologists had discovered that this material, now often missing from streams, was crucial for anchoring the stream channel and gravel bars in streambeds.

While the problems with the region's fisheries had become evident during the 1980s, by the 1990s, the general decline of salmon runs had reached a critical point, which further called the reliance on hatcheries into question. In 1991, the Endangered Species Committee of the American Fisheries Society published its assessment on Pacific anadromous fish stocks outside of Alaska and the findings were disturbing. More than half of the stocks in Washington, Idaho, Oregon, and California were at risk of extinction, or were of "special concern." The report concluded that the region's management of fisheries was not working. The authors thus called for "a new paradigm that advances habitat restoration and ecosystem function rather than hatchery production" (Mighetto, 2000).

Subsequent events supported this dismal conclusion. Late in 1991, NMFS listed three stocks of salmon in the Snake River under the ESA. By the end of the decade, NMFS had listed nine additional salmon species in the Pacific Northwest, affecting the economies of Portland and Seattle as well as smaller communities in the region. Salmon decline was a highly visible, politicized issue that reflected a larger historical trend; the realization that the region's natural resources were limited. The perception of the Pacific Northwest as a place offering the wealth of nature's bounty in unlimited quantities had come to an end and scientists, economists, and policy makers were faced with the challenge of managing the resource in light of this fact. They were also faced with making decisions that affected increasingly diverse interests. Throughout the region's newspapers the words "balance" and "trade-off" appeared with increasing frequency, indicating that the future would bring difficult choices.

2.5 Environmental Movement

Underlying the changes in tribal, commercial, and recreational fisheries was a shifting perception of the role of salmon in the Pacific Northwest. The 1970s became a crucial decade in the story of the region's salmon and the various users. As the environmental movement took hold across the nation,

it had a significant impact on natural resource issues in the region. Conservationists in the early part of the 20th century had focused on the need to use the country's natural resources wisely. Rather than seeking protection of natural areas such as forest and rivers, they wanted to use these resources in an efficient and sustainable manner. By the 1970s, however, arguments for protecting natural resources adopted a broader, more holistic, approach—one that would eventually look at ecosystems rather than individual species.

Several major forces encouraged the emergence of environmentalism. First, during the period of World War II, scientists had become concerned about radiation fallout, pesticides, and other contaminants that affected humans as well as fish and wildlife populations. The large variety and volume of hazardous substances released into our nation's land, water, and air alarmed the public. Second, the weakness in early fish and game policy, which had focused on attempts to restrict harvests and eliminate predators, became apparent during the mid to late 20th century. Finally, the environmental movement drew upon the counterculture's questioning of traditional values, including the assumption that natural resources were nothing more than economic commodities.

These new ideals were reflected in the activities of NMFS, charged with the protection of anadromous fish. The agency's mandate dates back more than a century. In 1871, Congress created the position of Commissioner of Fish and Fisheries within the United States Treasury Department. Initially, the commissioner's duties included reporting on the declining populations of food fishes in United States waters and recommending conservation measures. In 1903, Congress assimilated the commission into the newly created U.S. Bureau of Fisheries within the Department of Commerce and Labor. The Bureau of Fisheries remained there until 1939 when Franklin Roosevelt transferred them to the Department of Interior. The following year he combined the bureau with the Department of Agriculture's Biological Survey, thereby creating the USFWS. In 1970, Congress returned the Bureau of Commercial Fisheries to the Commerce Department, where it became known as the NMFS.

As noted, the management of the nation's fish has been viewed as an economic issue. By placing the agency responsible for salmon and other anadromous species in the Treasury Department and the Commerce Department, Congress indicated that fish were primarily valuable as a commodity, and that their contribution to our society was largely as economic capital. Salmon were viewed as being a crop that, with proper management and technological advancements, could produce high yields for human consumption. The concept of fish as crops was nothing new to foresters, whose primary agency (USDA Forest Service) was located in the Department of Agriculture. For decades the USDA Forest Service had advocated that timber production could best be managed on tree farms.

By the 1970s, NMFS, like other Federal agencies, had incorporated environmental ideals into its policy and management. The Endangered Species Act (ESA) of 1973 had established a set of regulations preventing the harvesting, possession, sale, and delivery of threatened and endangered species. It also required agencies such as NMFS to develop plans to recover animal populations listed as threatened or endangered. Few environmental statutes have wielded more impact than the ESA. Although Congress passed endangered species legislation in 1966 and 1969, the amended statute of 1973 proved to be one of the strongest statutes of the era. Its passage signaled that preventing extinction and protecting biodiversity had become major goals of natural resource policy at the national level.

The consequences of the ESA of 1973 proved to be especially far-reaching. The NMFS identified those species whose populations had dropped so low that they appeared likely to become endangered as "threatened," and those species that appeared in danger of becoming extinct as "endangered." Called the "pit bull of environmental law," the ESA established a set of regulations preventing the harvesting, possession, sale, and delivery of threatened and endangered species. It also required the appropriate agencies to develop a plan to recover animal populations listed as threatened or endangered. For the first time, natural resource managers in the public and private sectors had a Federal mandate to give high priority to endangered species and their habitat requirements. The variety of efforts, organizations, processes, and regulations concerned with present-day salmon recovery revolve around responding to and preventing ESA listing.

3. Significant Events and Documents Since 1990

This section summarizes significant events and documents related to the Corps' management of facilities on the lower Snake River since 1990, when the Salmon Summit was convened and the NMFS was first petitioned to list Snake River sockeye (*Oncorhynchus nerka*) as endangered under the ESA. The events and documents have been discussed, to the extent possible, in chronological order, although many significant activities have occurred simultaneously. Figure 1-1 summarizes key documents, EISs/EAs, or ESA listings since 1990 for Columbia River salmon and steelheads recovery planning efforts.

3.1 Salmon Summit

Senator Mark Hatfield of Oregon organized the Northwest Salmon Summit in Portland in 1990 to explore various ideas for fish protection (Mighetto and Ebel, 1994). Conducted before any Snake River salmon populations were listed under the ESA, the Summit intended to reach a consensus among Pacific Northwest interests and formulate a plan to address the problem of declining salmon stocks. In addition, participants were expected to suggest an appropriate response to NMFS' pending ESA listing of salmon. The Summit included the governors of Washington, Oregon, Idaho, and Montana, as well as 30 official members representing 28 organizations responsible for water management, power production or marketing, and fisheries management.

Participants divided into four separate task groups to study fish harvest, river flow, salmon production, and enforcement problems. The meetings began in October 1990 and continued into 1991. Although members developed various proposals, the divergent interests represented at the Summit did not reach an agreement on a fundamental approach to the problem. By the last formal meeting, held in early March 1991, Summit participants had not reached a consensus on a comprehensive plan of action or mitigation of impacts.

One of the most controversial proposals to emerge from the Summit was the idea of drawing down the reservoirs on the lower Snake River by as much as 30 meters (100 feet) or more (Mighetto and Ebel, 1994). Proponents believed that increased spill and water velocity during the spring migration would "flush" juvenile fish downstream, reducing their journey of approximately 30 days to 16 or 17 days. They believed that reduced migration time would increase survival by, among other things, decreasing the amount of time fish were exposed to predators. In 1991, it seemed that Summit participants reached an agreement for a one-year implementation plan. However, concern for adverse impacts of lowered water levels on shipping, port operation, recreation, and farming reduced the scope of actions agreed upon. Although the Salmon Summit failed to agree on a plan to save the salmon, the meetings contributed to the NMFS decision not to invoke an emergency listing for the sockeye salmon. Although the Summit's efforts did not prevent the ESA final listing, it did succeed in bringing a broad array of interests into recovery discussions. Participants, including the Corps, agreed to continue efforts to rebuild the depleted Columbia-Snake River system salmon stocks.

3.2 Endangered Species Act Listings for Northwest Salmon

On April 2, 1990, NMFS received a petition from the Shoshone Bannock Tribes of the Fort Hall Reservation, Idaho, to list Snake River sockeye as endangered under the ESA [Snake River Salmon

Recovery Team (SRSRT), 1994]. On June 7, 1990, NMFS received petitions from Oregon Trout, with co-petitioners Oregon Natural Resources Council, the Northwest Environmental Defense Center, American Rivers, and the Idaho and Oregon chapters of the American Fisheries Society to list Snake River spring chinook, Snake River summer chinook, and Snake River fall chinook (*O. tshawytscha*) under the ESA (SRSRT, 1994).

NMFS published notices on June 5, 1990 (55 Federal Register 22942) and September 11, 1990 (55 Federal Register 37342) stating that the petitions presented substantial scientific information indicating that the listings may be warranted (SRSRT, 1994). NMFS initiated a review of the status of each fish, and requested further biological information from the public. Status reviews for Snake River sockeye (Waples et al., 1991a), Snake River spring/summer chinook (Matthews and Waples, 1991), and Snake River fall chinook (Waples et al., 1991b) compiled the scientific information that led to the proposed listing of Snake River sockeye as endangered, and Snake River spring/summer chinook and Snake River fall chinook salmon as threatened (SRSRT, 1994).

Similar petitions and status reviews have been conducted for other groups of salmon or steelhead in the FCRPS. Overall, since 1991, 12 have been listed as follows:

- Snake River (SR) sockeye salmon (*O. nerka;* listed as endangered on November 20, 1991 [56 Federal Register 58619]); critical habitat designated on December 28, 1993 [58 Federal Register 68543]
- Snake River (SR) spring/summer chinook salmon (*Oncorhynchus tshawytscha;* listed as threatened on April 22, 1992 [57 FR 14653]); critical habitat designated on December 28, 1993 [58 Federal Register 68543], and revised on October 25, 1999 [64 Federal Register 57399]
- Snake River (SR) fall chinook salmon (*O. tshawytscha;* listed as threatened on April 22, 1992 [57 Federal Register 14653]); critical habitat designated on December 28, 1993 [58 Federal Register 68543]
- Snake River (SR) steelhead (*O. mykiss;* listed as threatened on August 18, 1997 ([62 Federal Register 43937]); critical habitat designated on February 16, 2000 [65 Federal Register 7764]
- Upper Columbia River (UCR) steelhead (*O. mykiss;* listed as endangered on August 18, 1997 [62 Federal Register 43937]); critical habitat designated on February 16, 2000 [65 Federal Register 7764]
- Lower Columbia River (LCR) steelhead (*O. mykiss;* listed as threatened on March 19, 1998 [63 Federal Register 13347]); critical habitat designated on February 16, 2000 [65 Federal Register 7764]
- Upper Willamette River (UWR) chinook salmon (*O. tshawytscha;* listed as endangered on March 24, 1999 [64 Federal Register 14308]); critical habitat designated on February 16, 2000 [65 Federal Register 7764]
- Upper Columbia River (UCR) spring chinook salmon (*O. tshawytscha;* listed as threatened on March 24, 1999 [64 Federal Register 14308]); critical habitat designated on February 16, 2000 [65 Federal Register 7764]

- Lower Columbia River (LCR) chinook salmon (*O. tshawytscha*; listed on March 24, 1999 (64 Federal Register 14308]); critical habitat designated on February 16, 2000 [65 FR 7764].
- Columbia River (CR) chum salmon (*O. keta;* listed as threatened on March 25, 1999 [64 Federal Register 14508]); critical habitat designated on February 16, 2000 [65 Federal Register 7764]
- Middle Columbia River (MCR) steelhead (*O. mykiss;* listed as threatened on March 25, 1999 [64 Federal Register 14517]); critical habitat designated on February 16, 2000 [65 Federal Register 7764]
- Upper Willamette River (UWR) steelhead (*O. mykiss;* listed as threatened on March 25, 1999 [64 Federal Register 14517]); critical habitat designated on February 16, 2000 [65 Federal Register 7764]

3.3 Northwest Power Planning Council Fish and Wildlife Program

The Northwest Power Planning Council (NPPC) was authorized by the Pacific Northwest Electric Planning and Conservation Act of 1980 (16 USC 839d-1). NPPC is made up of representatives from the states of Idaho, Montana, Oregon, and Washington and is entrusted with the responsibility of finding ways to acquire and market new power sources while giving equitable treatment to fish and wildlife. In 1982, the NPPC issued a comprehensive Columbia River Basin Fish and Wildlife Program (CRBFWP) that addressed salmon and steelhead production, safe passage, and harvest management; resident fish and wildlife protection; future hydroelectric development; and coordination among Federal agencies responsible for Columbia River Basin resources.

In 1991, the NPPC began a series of amendments to the Fish and Wildlife Program to institute a regional salmon and steelhead rebuilding plan. The NPPC was responding to a request from the Northwest Governors, the congressional delegation, and NMFS to develop a comprehensive salmon plan. All three entities had expressed interest in a regionally developed plan that NMFS could use as a basis for formulating its salmon recovery plan under the ESA. Although the focus of NPPC's efforts was the petitioned stocks, NPPC also believed that the measures it adopted would help all weak stocks. The purposes of the NPPC's amendments are to preserve the ecological and genetic diversity of the runs while rebuilding their overall numbers. In its efforts to produce a comprehensive plan, the NPPC considered all measures that could benefit salmon and steelhead, regardless of who should implement those measures (NPPC, 1991).

Phase I of the amendment process, which took place during the summer of 1991, focused on emergency habitat and production actions. Phase II amendments, completed in December 1991, concentrated primarily on fish survival during migration in the mainstems of the Columbia and Snake Rivers and on harvest. Phase II also introduced the concept of a framework that ties existing and future salmon rebuilding actions together into a comprehensive plan; the plan was based on stated goals and objectives, with performance standards and schedules to measure progress.

The NPPC currently makes annual funding recommendations to the BPA for projects to implement under the Fish and Wildlife Program. These projects are focused on protecting, mitigating, or enhancing fish and wildlife in the Columbia River Basin that have been impacted by hydroelectric dams.

Annex A contains excerpts from the amendments.

3.3.1 Independent Scientific Group Review of NPPC's Fish and Wildlife Program

In the December 1994 amendments to the CRBFWP, the NPPC called on the BPA to fund the Independent Scientific Group (ISG) to conduct a biennial review of the science underlying salmon and steelhead recovery efforts and Columbia River Basin ecosystem health. The NPPC's objective was to provide the region, to the greatest extent possible, clear analysis conducted by impartial experts.

The NPPC also asked that the ISG develop a conceptual foundation for the fish and wildlife program, to provide an overall set of scientific principles and assumptions on which the program and fish and wildlife management activities basinwide could be based and against which they could be evaluated. On September 18, 1996, the ISG delivered its report *Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem* to the NPPC (ISG, 1996). The report contains the first biennial review and a proposed conceptual foundation for the Fish and Wildlife Program. After an introductory chapter, the report is divided into four main components: Chapter 2 contains the proposed conceptual foundation for the Fish and Wildlife Program; Chapter 3 contains the review of scientific basis for measures included in the current Fish and Wildlife Program, using the conceptual foundation as a template for this evaluation; Chapters 4 through 10 contain the detailed technical data and documentation on which Chapters 2 and 3 are based; Chapter 11 describes general conclusions from the ISG review.

In submitting its report, the ISG expressed the hope that the report will be a valuable resource for decisionmakers. The findings should enable fishery managers to focus future research activities on areas that still are not thoroughly understood. However, the review does not include policy recommendations for recovery and restoration. Nor does it recommend specific measures or strategies or deal with institutional structures. It is not an implementation plan. Instead, the conceptual foundation proposed in the report should provide the scientific foundation for public policy to be developed by the NPPC and other decisionmaking bodies. It can be used to guide salmon restoration activities in general, as well as future development of the CRBFWP.

Annex A contains excerpts from the ISG Report (1996).

3.3.2 NPPC Multi-Species Framework

The ISG, in their report *Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem* (ISG, 1996) reviewed the NPPC's CRBFWP and criticized it for lacking a scientific foundation and vision for guiding the selection and implementation of projects. As a response, the Fish and Wildlife Program initiated the Multi-Species Framework Project in November 1998. The project sought input from individuals, state and Federal agencies, Indian tribes, environmental groups, and industry to develop alternative visions of the future Columbia River Basin and potential recovery actions for fish and wildlife in the basin. The potential actions ranged from flow modifications to dam breaching, acquisition and protection of habitat to expansion or reduction of hatcheries, and monitoring and research to passage barrier removal. The proposed actions were not limited to just those that the CRBFWP has authority to fund. Over 100 possible actions were proposed and from these, seven alternative visions were developed that included a specific suite of management actions. The visions for the basin ranged from a connected self-sustaining ecosystem with reduced power production, hatcheries, and in-river transportation (Alternative 1) to maximized economic production from river operations to finance habitat restoration and hatcheries (Alternative 7).

The alternatives were subsequently analyzed by a Human Effects Analysis Team and a custom implementation of Ecosystem Diagnosis and Treatment (EDT), an expert system that assessed the potential biological outcome from each alternative. No alternative was selected for implementation. Instead, the Multi-Species Framework process was used as a tool to help in the restructuring of the CRBFWP and development of the underlying framework and vision found lacking by the ISG.

3.3.3 Revised NPPC Columbia River Basin Fish and Wildlife Program

In early 2000, the NPPC re-initiated the process of amending the CRBFWP. Based upon the Independent Science Group review of the program and the Multi-Species Framework, a major revision of the CRBFWP evolved. An important revision to the program was inclusion of eight scientific principles and an overall vision to guide the program. In its broadest perspective, "The vision for this program is a Columbia River ecosystem that sustains an abundant, productive and diverse community of fish and wildlife, mitigating across the basin for the adverse effects to fish and wildlife caused by the development and operation of the hydrosystem and providing the benefits from fish and wildlife valued by the people of the region" (NPPC, 2000).

Based upon the strategy developed by the Federal Caucus (see Section 3.26), the CRBFWP assumes that dam breaching will not occur within the near future. The focus of the program is on fish and wildlife habitat through protection, restoration, and mitigation projects. However, the program also considers other types of projects including:

- Hydropower (flow management, fish transportation and passage)
- Data management
- Research, monitoring, and evaluation (including ocean conditions)
- Supplemental and production hatcheries (to replace lost habitat and extirpated populations).

Funding priorities for projects are to be based upon consistency with the overall vision, objectives, and strategy of the program and the specific biological objectives developed within individual subbasin plans. The biological objectives include both biological performance (abundance, capacity, productivity, and life history diversity) and the desired future environmental conditions. Although the NPPC has no authority over fishing regulations, the plans must also consider how harvest interacts with the biological objectives. Existing and proposed projects undergo a rolling 3-year review process by the Independent Scientific Review Panel (i.e., a third of the projects are reviewed each year).

3.4 System Configuration Study

The System Configuration Study (SCS) was initiated by the Corps in 1991 to evaluate the technical, environmental, and economic effects of potential modifications to the configuration of Federal dams and reservoirs on the Snake and Columbia Rivers with the goal of improving survival rates for anadromous salmonids migrating downriver (Corps, 1996). The SCS evolved in response to the NPPC's Fish and Wildlife Program Amendments (Phase Two) issued in December 1991 (Corps, 1996).

The SCS has been conducted in two separate phases (Corps, 1996). Phase I, a reconnaissance-level assessment of multiple concepts, including drawdown, upstream collection, additional reservoir storage, a migratory canal, and several other alternatives, was completed in June 1995 (Corps, 1996). Phase II is a detailed assessment of the alternatives that emerged from Phase I as holding the greatest potential benefit for anadromous salmonids (Corps, 1996).

3.4.1 SCS Phase I

Alternatives examined under Phase I, a reconnaissance-level screening of alternatives, included: 1) changes to existing facilities to improve passage and survival rates of juveniles and adults; 2) the possible addition of upstream water storage sites to be used for river flow and temperature modifications (the BOR is leading an interagency assessment of potential new dam sites); 3) annual drawdowns of four lower Snake and the John Day (lower Columbia) reservoirs to various levels during juvenile migration periods; and 4) the addition of new facilities, upstream of Lower Granite Dam, to collect juveniles and divert them onto a barge or into a migratory canal along the river, or a floating or underwater pressurized pipeline (in conjunction with Alternative 4).

The Corps initially had 22 options under Alternative 3 (above) pertaining to possible drawdowns of lower Snake facilities (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor). The initial screening, based on engineering feasibility, biological effectiveness [a Technical Advisory Group (TAG) assessed the biological impacts and effectiveness of alternatives being considered under Phase I; the TAG included representatives from the Corps and other Federal and state agencies, interest groups, and the biological community], and acceptability, eliminated 12 options. Additional screening narrowed the list to three drawdown options to be considered in greater detail in Phase II: 1) seasonal, near spillway crest drawdown; 2) seasonal, near natural river drawdown; and 3) permanent, near natural river drawdown.

3.4.2 SCS Phase II

SCS Phase II has developed into a major program containing many separate and specific studies (Corps, 1996). The Lower Snake River Juvenile Salmon Migration Feasibility Study is part of SCS Phase II, and is considered separately in Section 3.23. This growth in the scope of Phase II was considered necessary to adequately and efficiently respond to the requirements for multiple evaluations addressed in the NMFS 1995 Biological Opinion.

3.5 Columbia River Salmon Flow Measures Options Analysis/Environmental Impact Statement

In May 1991, the Corps, with BPA and BOR as cooperating agencies, began preparation of the 1992 Options Analysis/Environmental Impact Statement (OA/EIS) on the effects of operational changes at certain Federal multipurpose water projects in the FCRPS. The OA/EIS was undertaken to analyze effects of proposed changes to the FCRPS in response to several actions: the November 20, 1991 listing of the Snake River sockeye salmon as endangered under the ESA; the proposed listing of several other wild salmon stocks as endangered or threatened; discussions during the Salmon Summit; and recommendations contained in the Phase II amendments of NPPC's Fish and Wildlife Program. The final OA/EIS was issued in January 1992 (Corps, 1992).

The OA/EIS considered several alternative water management actions that could be taken in 1992 at dam and reservoir projects along the lower Snake and Columbia Rivers to improve juvenile and adult anadromous salmon migration conditions. Options considered were grouped into five general alternatives: 1) no action; 2) reservoir drawdown (including short-term tests); 3) flow augmentation; 4) combination of drawdown and flow augmentation; and 5) temperature control test. The action alternatives were designed to increase the velocity of the water, which in turn would pass the young salmon downstream faster during the April to August migration.

Several drawdown proposals were considered for all or part of the April to August migration, ranging from drawing down the reservoirs to the minimum normal operating level, to lowering the elevation of certain reservoirs to near the level of the overflow structure of the dam (spillway). The Corps identified eight options that fell within these drawdown ranges and also met operating considerations and flow velocity objectives. Six of the options applied to the lower Snake River facilities.

With flow augmentation, additional water would be released from storage reservoirs in the spring to increase the river flow during juvenile fish migration. Options considered varied with respect to the source of the water used to augment flows, the volume storage to be released, and the timing of releases. Based on computer analyses of combinations of options that provide significant increases in flow velocities, three combinations were identified as likely scenarios and were discussed in this OA/EIS. Release options were also considered to improve conditions for adult salmon migrating in the fall.

The environmental impacts of the proposed actions considered in the OA/EIS included the effects of altering normal river operations on a number of resource areas: water quality, anadromous fish, resident fish, wildlife, soils, air quality, transportation, agriculture, power, recreation, aesthetics, cultural resources, socioeconomics, and dam safety.

The preferred alternative for 1992 included: 1) drafting all four lower Snake River facilities to minimum operating pool (MOP) from April 1 to July 31; 2) conducting a drawdown test of Lower Granite and Little Goose in March; 3) operating the John Day reservoir at 80 meters (262.5 feet) (the minimum pool at which irrigation pumps will function) from May 1 through August 31, or until irrigation impacts are realized; 4) augmenting the lower Snake River flow with 111,060 hectare-meters (900 thousand acre-feet) or more from Dworkshak and variable releases to meet a target flow of 2,832 cubic meters per second (100 thousand cubic feet per second) at Lower Granite from April 15 through May 31; 5) augmenting the lower Columbia River flow up to 370,200 hectare-meters (3 million acre-feet) or less to meet target flow of 5,664 cubic meters per second (200 thousand cubic feet per second) at The Dalles from May 1 through June 30; and 6) releasing up to 44,424 hectare-meters (360 thousand acre-feet) from Dworshak in August to test temperature control options.

3.6 Reservoir Drawdown Test

As part of the 1992 Operation Plan, the Corps conducted a test drawdown at the Lower Granite and Little Goose facilities on the lower Snake River. The test was intended primarily to determine the physical effects of partial drawdown. As such, the test was scheduled to occur when few anadromous fish were present in the river. The idea behind the drawdown concept was to increase river velocities to more closely resemble natural juvenile migration conditions. In March 1992, the Corps drafted Lower Granite 11 meters (36 feet) and Little Goose 3.8 meters (12.5 feet) below the MOP levels for which they were designed. Nine spill tests were also conducted during the drawdown to determine impacts to structures, gas supersaturation levels from spilling, and potential adult passage conditions at these lower reservoir elevations.

Conclusions in the Corps' report (Corps, 1993a) on the drawdown experiment include:

- There was no major damage to dam facility structures and minor stilling basin damage.
- Turbines continued to operate safely, but efficiency decreased (potentially indicating increase in juvenile fish mortality); there was some vibration in the turbines.
- Water velocity measurements indicated that water velocities increased substantially in the upstream end of the reservoir as it returned to a near-natural river; in the lower reservoir, drawdown effects on velocity were considerably reduced in the deeper water near the dam.
- There was an increase in dissolved gas supersaturation in the stilling basin (which may result in gas bubble trauma in fish) during spill. Dissolved gas levels as a result of spills ranged up to 135 percent, from a background of 100 to 104 percent. The supersaturation level was related to total spill discharge.
- Some roads and railroad beds were damaged and embankment sloughs occurred in various areas along the reservoir.
- Large numbers of resident fish, clams, mussels, and crayfish were lost due to receding water elevations.

The test stopped commercial barge traffic and caused some damage to floating docks; structures located adjacent to or on rivers edge, well systems, irrigation systems, and recreation areas. Exposed cultural resources were mapped and documented during the test and precautions were taken to protect exposed artifacts.

3.7 NMFS Biological Opinion on Proposed 1992 Operations of the Federal Columbia River Power System

The listing of the Snake River sockeye as endangered under the ESA required the Corps to conduct formal consultations with NMFS on any action "authorized, funded, or carried out" by the Corps to ensure that said action "is not likely to jeopardize the continued existence of any endangered species or threatened species" (Section 7 of the ESA). Such consultation would involve the preparation of a biological assessment (BA) on the part of the Corps, and if necessary the issuance of a biological opinion by NMFS. The BA presents the Corps' assessment of whether or not the proposed actions would jeopardize the listed species, while the biological opinion is NMFS's opinion. A biological opinion is only required if the BA results in at least a "may affect, likely to adversely affect" determination.

Because the Snake River sockeye was listed as endangered in December 1991, consultation was added to the process of selecting the preferred river operation alternative in the 1992 OA/EIS. The consultation began on December 20, the day the ESA listing took effect. The Corps submitted a BA of actions proposed to increase velocities in Snake and Columbia River reservoirs as well as its draft Fish Passage Plan for 1992; BPA submitted a BA of the 1992 Operation of the FCRPS. NMFS reviewed this information, as well as modifications to the 1992 FCRPS Operations generated during the consultation process, and issued its required biological opinion on April 10, 1992 (NMFS, 1992). The biological opinion concluded, "that the proposed operations are not likely to jeopardize the continued existence of listed or proposed salmon species." However, in its transmittal letter NMFS included the caveat that it was "concerned that if operation of FCRPS continued as is proposed for

1992, it would not be sufficient to reverse the decline over one lifecycle of the salmon; therefore, additional steps will likely be needed in 1993 and future years."

3.8 Corps Operations Plan

After NMFS issued its biological opinion, the Corps issued a Record of Decision (ROD) that described its Operations Plan for 1992. The following measures were included in the Operations Plan:

- conduct a drawdown test at Lower Granite/Little Goose (addressed by a separate ROD issued in February 1992)
- operate lower Snake River facilities near MOP April 1 to July 31
- operate the John Day reservoir near 80 meters (262.5 feet) elevation from May 1 to August 31, unless impacts to irrigation intakes result
- conduct various flow augmentation releases from Dworshak Dam during salmon migration periods
- release water from Grand Coulee and Arrow Dams for flow augmentation from May 1 to June 30
- monitor and evaluate use of available water throughout the fish passage season
- continue release of additional water over spillways according to spill agreement
- continue fish transport
- continue improvements of fish passage systems.

3.9 Interim Columbia and Snake Rivers Flow Improvement Measures for Salmon Final Supplemental Environmental Impact Statement

The Interim Columbia and Snake Rivers Flow Improvement Measures for Salmon Final Supplemental Environmental Impact Statement (SEIS) evaluated the impacts of several alternatives for operating certain dams and reservoirs on the FCRPS during 1993 and future years until a long-term plan of action could be developed (based on results of ongoing long-term studies). The Corps in cooperation with BPA and BOR prepared the SEIS. The proposed action was being considered in response to the ESA listing for Snake River salmon. The SEIS was issued in March 1993 (Corps, 1993b).

The SEIS examined actions similar to those evaluated in the Columbia River Salmon Flow Measures OA/EIS (Corps, 1992), but as a recurring annual event over a longer time period. It also analyzed the impacts of such actions on projects not addressed in the OA/EIS. To conform to Council on Environmental Quality (CEQ) guidelines, the SEIS was "tiered" to the 1992 OA/EIS; this means that discussions and analyses from the OA/EIS, if there were no change, were generally summarized and incorporated by reference into the SEIS.

The SEIS addressed water management activities to be implemented in 1993 and planned for future years until the plan of action may be changed as a result of long-term studies. The actions

considered in the SEIS involved some combination of measures similar to those selected in the 1992 OA/EIS and identified through consultation with NMFS under Section 7 of the ESA.

Specifically, the SEIS presented five alternatives:

1) A 1992 operation alternative without project conditions, or the no-action alternative, which represent water management actions undertaken from 1985 through 1990
2) A 1992 operation alternative excluding the March drawdown test of Lower Granite and Little Goose
3) The 1992 operation alternative (without the March drawdown test) modeled to display potential impacts to Libby and Hungry Horse under different operating assumptions
4) A modified 1992 operation alternative (without the March test drawdown), including improvement to salmon flows from Dworshak
5) The modified 1992 operation alternative (without the March test drawdown), modeled to show water from the upper Snake.

As with the 1992 OA/EIS, the environmental impacts of the proposed actions considered in this SEIS included the effects of altering normal river operations on a number of resource areas: water quality, anadromous fish, resident fish, wildlife, soils, air quality, transportation, agriculture, power, recreation, aesthetics, cultural resources, socioeconomics, and project structures.

The fourth alternative, involving modifications to the 1992-operating plan, was identified as the preferred alternative. It was selected on the basis of salmon survival effects, cost effectiveness, environmental effects, and the scope of existing authorities.

3.10 NMFS Biological Opinion on Proposed 1993 Operations of the FCRPS

On May 26, 1993, NMFS issued its biological opinion for 1993 operations of the FCRPS (NMFS, 1993). The biological opinion was based on a number of documents provided by the Corps, including the SEIS, as well as modifications to the 1993 Operations Plan developed during the intense consultation process. In the cover letter to the biological opinion, the NMFS Acting Assistant Administrator for Fisheries stated:

> *Operation of the FCRPS is a major factor in the decline of listed Snake River salmon. However, NMFS has determined that flow augmentation measures, adopted by the Federal agencies in the May 12, 1993 letter, and other measures including, spill improvement in structures and fish bypass facilities, and monitoring activities have reduced the anticipated mortality of listed Snake River salmon adequately for the purposes of the 1993 consultations to a level that is not likely to jeopardize the continued existence of the listed species. The Recovery Plan is expected to identify long-term, comprehensive, planning actions that will initiate the recovery of the listed Snake River salmon. Guidelines established by the Recovery Plan will be the basis for NMFS Section 7 consultations when the Plan is final.*

3.11 NMFS Biological Opinion on Proposed 1994 to 1999 Operation of the FCRPS and Juvenile Transportation Program in 1994 to 1998

This consultation concerned operations of the FCRPS from 1994 through January 31, 1999. NMFS considered a plan of actions for the FCRPS that the action agencies (Corps, BPA, BOR) proposed on December 2, 1993 in their BA and in revisions submitted in January 1994. NMFS issued its biological opinion on March 16, 1994 (NMFS, 1994). The biological opinion and the action agencies' RODs concluded that the proposed operation of the FCRPS was not likely to jeopardize the continued existence of the endangered or then threatened Snake River salmon species. The biological opinion included an incidental take statement pursuant to Section 7(a)(4) of the ESA which required that the action agencies comply with certain reasonable and prudent measure, terms, and conditions intended to further avoid and minimize take of listed salmon.

3.12 Litigation and Court Decision (*Idaho Department of Fish and Game v. National Marine Fisheries Service*)

At the same time the 1994 consultation was in progress, the Idaho Department of Fish and Game (IDFG), the state of Oregon, and four treaty tribes challenged the legal adequacy of NMFS' 1993 biological opinion for FCRPS Operations in Federal district court proceedings (*Idaho Department of Fish and Game v. National Marine Fisheries Service*, Civ. No. 92-973-MA (Lead Case), 93-1420-MA, 93-1603-MA, (D. Or.) (*IDFG v. NMFS*). In a judgment entered on April 28, 1994, the Court ordered on page 4 that:

> *IT IS FURTHER ORDERED AND ADJUDGED that the biological opinion on 1993 Federal Columbia River Power System operations prepared by the National Marine Fisheries Service, and the records of decision prepared by the Corps of Engineers and Bureau of Reclamation in reliance upon said biological opinion, for the reasons stated in this court's opinion of March 28, 1994, are arbitrary and capricious and otherwise not in accordance with the purposes of the Endangered Species Act, Section 7(a)(4), with respect to the chosen jeopardy standard and their consideration of reasonable and prudent alternatives to avoid jeopardy. That the 1993 biological opinion and records of decision are set aside and remanded to review and reconsider them, or at their option, to review and reconsider the 1994-98 hydropower biological opinion, in light of the (sic) court's order of March 28, 1994, and to submit a biological opinion and records of decision to address that ruling by June 27, 1994, unless that date is extended by further order of this court.*

NMFS and the action agencies, the defendants in this lawsuit, opted to reconsider the newly issued 1994 to 1998 FCRPS biological opinion rather than expend limited resources reconsidering the challenged 1993 opinion about FCRPS actions that were then completed. The Federal agencies further decided to work cooperatively with all the other parties, and particularly with the states and treaty tribes, rather than appealing the judgment and continuing to litigate the issues raised in the case.

From May 9, 1994, through November 30, 1994, NMFS and the action agencies (the Corps and BOR) participated in a series of discussions and working groups with the parties to this litigation. The purpose of these discussions was to better facilitate the collection and consideration of credible and relevant scientific evidence in a re-evaluation of the application of the standards of ESA Section

7(a)(2) to the FCRPS and of alternatives and measures for FCRPS operation and facilities. The Federal agencies and other parties to the litigation were aided by technical assistance provided through interagency working groups of technical personnel; one to consider the biological requirements of the listed species and the other to inventory and evaluate alternative actions and measures for the FCRPS.

The Court extended the original deadline established by the Judgment directing the issuance of a new biological opinion by January 30, 1995 (*IDFG v. NMFS*, Civil Minutes, Record of Order dated October 18, 1994: Granting Federal defendants October 8, 1994, request for extension of time as set forth in the schedule attached to William Stelle, Jr.'s affidavit). The Court granted further extensions in this deadline until March 1, 1995.

3.13 Snake River Salmon Recovery Team's Final Recommendations to the National Marine Fisheries Service

Following the listing of Snake River sockeye salmon as an endangered species, NMFS appointed the SRSRT to independently develop recommendations for a Recovery Plan for the species (as required under Section 4(f) of the ESA). Upon subsequent listings of Snake River spring/summer and fall chinook salmon as threatened species, SRSRT's responsibilities were expanded to include these fish as well (SRSRT, 1994).

The SRSRT developed draft recovery plan recommendations over the course of 27 months by compiling available information through an open public process. The SRSRT visited areas in the range (past and present distribution) of listed Snake River salmon and sought scientific, cultural, and economic expertise from parties throughout the region (SRSRT, 1994).

On October 20 1993, the SRSRT released draft recovery plan recommendations and solicited peer review to ensure that the factual materials were correct and that their analysis and interpretations were scientifically sound. SRSRT revised their recommendations based on comments received, updated information, and new analyses, and issued their final recommendations in May 1994.

3.14 Lower Snake River Biological Drawdown Test Draft Environmental Impact Statement

The Corps and NMFS as joint lead agencies, along with the BPA as a cooperating agency, analyzed four general alternatives intended to provide information on the biological effects of reservoir drawdown on migrating juvenile salmon and steelhead. The test would also provide an opportunity to study the effects of reservoir drawdown on adult salmonids, resident fish, wildlife, and other components of the lower Snake River ecosystem. These four alternatives included Alternative 1, No Action, and three different ways to conduct a biological drawdown test at the Lower Granite reservoir on the lower Snake River in Washington State. These action alternatives were: Alternative 2, using sanctuary dipnets or gatewell baskets to remove fish guided to the gatewell slots at the dam; Alternative 3, using a new gatewell tank removal system to bypass juvenile fish entering the powerhouse; and Alternative 4, using a new lower-level bypass system to divert fish entering the powerhouse.

The alternatives could have been implemented with the project spillway or the powerhouse as the primary route of downstream passage. The action alternatives had multiple options for spring, summer, or spring-summer test durations. The drawdown test could have been done for only one migration season, or could be repeated for up to 4 years. The preferred alternative of the agencies

was Option 3A, a 2-month drawdown of the Lower Granite reservoir in spring 1996. However, findings from ongoing studies and data collection by scientists of the NMFS and the University of Washington School of Fisheries Center for Quantitative Science indicated that juvenile salmon migrating through the Lower Granite reservoir experienced a much higher survival rate than originally thought—in excess of 90 percent. Because juvenile salmon survival was shown to be already high through the reservoir, it was determined to be likely that there would be insufficient change resulting from a drawdown test at Lower Granite to make meaningful statistical inferences. Because of this, the drawdown test was never implemented, and no final EIS was prepared.

3.15 NMFS Biological Opinion on Reinitiation of Section 7 Consultation on Proposed 1994 to 1998 Operation of the FCRPS and Juvenile Transportation Program in 1995 and Future Years

With the conclusion of the 1994 lawsuit and associated post-judgment discussions, this consultation was formally reinitiated by the action agencies on December 15, 1994. In a letter to NMFS transmitting the Supplemental BA on Federal Columbia River Power Operations, the action agencies identified the proposed action under consideration to be the 1994 to 1998 operations proposed in the previous consultation while at the same time considering longer-term changes in operations and structures such as those identified in their System Operations Review (SOR).

On March 2, 1995, NMFS issued its biological opinion (NMFS, 1995a). The biological opinion concluded that "the operation of the FCRPS as described in the 1994 to 98 biological opinion is likely to jeopardize the continued existence of listed" salmon stocks (spring/summer chinook, fall chinook, sockeye). The biological opinion also concluded "the only way to achieve significant improvements is with long term system reconfigurations."

The biological opinion included a "Reasonable and Prudent Alternative to the Proposed Action" (alternative) which identifies "immediate, intermediate and long term actions that will improve the operation and configuration of the hydropower system" and will lead to reduced mortality of the listed fish. The biological opinion states the following:

> *The alternative employs an adaptive approach to increasing survival and the probability of recovery of listed salmon, by taking immediate actions to improve mainstem survival while reducing the uncertainty about the likely benefits of, need for and feasibility of major system structural modifications. Immediate survival improvements include improved bypasses, increased spills and spring/summer flows, reduced fish handling, better fish transportation conditions, etc. Major structural modifications include installation of surface collectors and drawdowns (natural river or spillway crest).*

The alternative identified six immediate planning and evaluation efforts to address potential system modifications, including "complete necessary planning tasks to begin implementation of drawdown." The alternative also specified a formal decision path for the implementation of long-term alternatives (Corps, 1996); the path has two major decision points. The first was in 1996, when the Corps was to have completed an interim evaluation report and preliminary decision regarding the selection of one of three drawdown alternatives (seasonal, near spillway crest drawdown; seasonal, near natural river drawdown; permanent, near natural river drawdown) and surface collectors (Corps, 1996). If a decision on drawdown could not be made in 1996, a second decision point was

identified in 1999 (Corps, 1996). At that time, a final plan for drawdown or surface bypass collection would be selected, and feasibility evaluations and National Environmental Policy Act (NEPA) documentation would be completed (Corps, 1996).

3.16 Issuance of Corps' Record of Decision on Operations Plan for 1995 and Future Years

On March 10, 1995, the Corps issued its ROD on proposed operations of the FCRPS for 1995 and future years. The ROD documented the Corps' intent to fulfill the recommended measures in the NMFS Biological Opinion in an expeditious and responsive manner.

3.17 Supplements to the 1995 Biological Opinion

On May 14, 1998, NMFS issued the 1998 Supplemental FCRPS biological opinion. This ESA Section 7 consultation evaluated the effects of the configuration and operations of the FCRPS on newly listed threatened and endangered steelhead in the Upper Columbia River, Snake River, and Lower Columbia River ESUs.

In the 1998 Supplemental FCRPS biological opinion, NMFS determined that operating the FCRPS in accordance with the action agencies' proposed action, including the measures specified in the RPA of the 1995 FCRPS biological opinion (the 1995 RPA), would not jeopardize the continued existence of the newly listed steelhead. The 1998 Supplemental FCRPS biological opinion established spring flow objectives at Priest Rapids Dam to protect juvenile fish and expanded the spill program at many mainstem hydro projects, but otherwise left the decision-making process and timing for the long term as in the 1995 FCRPS biological opinion.

NMFS issued a second supplemental biological opinion on December 9, 1999. This biological opinion evaluated and documented BOR's planned operation to comply with the 1995 RPA prescription to deliver 427 thousand acre-feet (kaf) of upper Snake River water for flow augmentation and to review the operation of all BOR projects in the Snake River system above Lower Granite Dam. Again, the architecture of the long-term, decision-making process was unchanged from that set out in the 1995 RPA.

NMFS issued another supplemental biological opinion on February 4, 2000. That opinion considered the effects of FCRPS operations on six species that NMFS listed as threatened or endangered in March 1999. NMFS determined that the 1995 RPA, as modified by the 1998 proposed action and combined with a few additional interim measures, would not jeopardize the continued existence of any of the newly listed species for the rest of the interim period. The decision-making process and timing for the long term, again, remained consistent with the 1995 FCRPS biological opinion.

3.18 Action Agencies 1999 Biological Assessment

In December 1999, the action agencies issued a BA on the future operation of the entire FCRPS. This BA was developed to continue the consultation process initiated by the 1993 BA and to incorporate consideration on new listings made since that time and operational procedures for addressing potential impacts to juvenile migrants.

3.19 NMFS and USFWS 2000 Biological Opinions on Future Operation of the FCRPS

In December 2000, the NMFS and USFWS each issued biological opinions in response to the action agencies' 1999 BA on operation of the FCRPS. The USFWS biological opinion addressed bull trout in the FCRPS (listed under ESA as threatened) and Kootenai River White Sturgeon (listed under ESA as endangered).

The measures prescribed for Kootenai River White Sturgeon are focused on the operations of Libby and Hungry Horse Dams on the upper Columbia River. As a result, actions prescribed for Kootenai River White Sturgeon are not likely to affect the lower Snake River dams.

The FCRPS will be operated to meet objectives for Snake River Salmon Stocks, and Snake and Columbia River Steelhead Stocks. Measure to address bull trout are not specifically included in the operations for lower Snake River dams. In many cases, measures or actions for listed anadromous fish species may also address requirements for bull trout. Also, the USFWS has indicated that additional information is needed on the presence of, and use by, bull trout in the mainstem Snake River, including distribution, timing, and usage of the lower Snake River dams and reservoirs (USFWS, 2000).

The NMFS opinion addressed ESA-listed anadromous salmon or steelhead. The action agencies are currently reviewing both 2000 biological opinions and are developing an implementation plan in response to them.

In NMFS' 2000 biological opinion, operational and structural fish passage improvements at FCRPS projects were proposed to increase the survival of listed fish. The opinion presented specific hydropower measures that NMFS determined, based on the best scientific information, to be as follows:

- Biologically feasible and implementable
- Sufficient to achieve performance standards that represent the best the hydrosystem can do without dam breaching
- Sufficient to result in a high likelihood of survival and a moderate-to-high likelihood of recovery, combined with offsite mitigation measures and with other improvements affecting the listed species.

The hydrosystem measures are expected to reduce juvenile and adult salmonid mortality attributable to passage through the hydrosystem and to attain defined "performance standards" for recovery measures by 2010. The hydrosystem measures main features are described briefly below.

Proposed measures for improving water management so as to provide direct and indirect survival benefits to salmon include the following:

- Meet flow objectives at Lower Granite, Priest Rapids, McNary, and Bonneville Dams
- Provide in-season management for operational flexibility and best use of available water volumes
- Provide guidance on reservoir evaluations in early spring, early summer, and at the end of the summer flow augmentation season
- Coordinate with water release from Canada, the upper Snake River, and the Hells Canyon Complex
- Take specific actions to improve water management for salmon: 1) additional drafts of selected FCRPS reservoirs, 2) additional water from other sources, 3) shifts of flood control among projects, 4) implementation of flood control operations at the Libby and Hungry Horse reservoirs, 5) review of system flood control objectives, and 6) continued research on summer-migrating Snake River fall chinook salmon population losses.

The following actions are prescribed for improving juvenile passage survival through the FCRPS to the ocean:

- Increase spillway passage using gas abatement and longer spill hours to allow greater spill volumes; also, refine spill patterns and evaluate removable spillway weirs (RSWs) as ways of improving spill efficiency
- Conduct research on spillway passage to identify additional potential survival and passage improvements
- Increase screen/bypass system effectiveness with extended screens, new outfalls, and improved hydraulic conditions
- Develop and test surface bypass technology, with implementation as appropriate
- Provide improved turbine designs and operating guidelines
- Improve passage system operations and reliability.

Measures for improving juvenile reservoir survival, and thereby increasing the survival of downstream migrating salmon, include the following:

- Increase flow augmentation for summer migrants, particularly in the low water years
- Manage reservoir and run-of-river projects to reduce extreme water level fluctuations
- Manage predator populations (fishes, birds, and mammals).

Measures for improving adult survival are as follows:

- Develop actions to reduce fallback through turbines and over spillways
- Increase facility reliability and the ability to maintain operating criteria
- Investigate measures to protect steelhead kelts
- Investigate prespawning mortality.

Measures for improving water quality include the following:

- Make structural and operational modifications at spillways (e.g., spillway deflectors, improved spill patterns) to help reduce TDG levels
- Develop alternative fish passage measures (e.g., surface bypass)
- Release cool water from storage reservoirs (e.g., Dworshak Dam)
- Institute special powerhouse operations (e.g., McNary Dam).

NMFS proposed active investigation to reduce or resolve key uncertainties. Critical uncertainties relate primarily to the hypothesis of delayed mortality due to passage through the hydrosystem:

- Investigate delayed mortality of transported juvenile migrants (D-value when expressed relative to the survival of nontransported migrants below Bonneville Dam)
- Investigate delayed mortality of inriver juvenile migrants (extra mortality)
- Investigate delayed mortality or passage effects on adults
- Investigate estuarine/ocean survival.

3.20 A Proposed Recovery Plan for Snake River Salmon

In March 1995, NMFS published a Proposed Recovery Plan for Snake River Salmon, which aimed "to restore the health of the Columbia and Snake River ecosystem and to recover listed Salmon River stocks" (NMFS, 1995b). The proposed recovery plan was developed from recommendations made by the SRSRT in its May 1994 report to NMFS (SRSRT, 1994). The Recovery Plan includes the following:

> *The conservation of natural salmon and their habitat has not been afforded balanced consideration in past resource allocation decisions. Natural salmon are those that are the progeny of naturally spawning parents. Development in the Pacific Northwest has often proceeded with the assumption that improved technology or management would mitigate impacts on natural salmon stocks. The Region's reliance on uncertain mitigation schemes (as opposed to fundamental conservation strategies) has been a very costly approach, both for natural salmon and the public.*
>
> *However, recent efforts have concentrated on conserving natural salmon and their habitats. There is new emphasis being placed on natural fish escapement, improved migration conditions for juveniles and adults, increased riparian area protection, and equitable consideration of natural fish in resource allocation processes. This focus differs from previous management and represents important progress toward recovering listed Snake River salmon, restoring Columbia Basin ecosystem health, and benefiting other species presently in serious decline.*

Annex B contains a summary of Proposed Recovery Plan provisions related to mainstem survival of the listed salmon.

3.21 Final Environmental Impact Statement for Columbia River System Operation Review

The Columbia River SOR, a joint effort of the Corps, BPA, and BOR, was initiated on July 18, 1990 to review multipurpose management of the Columbia-Snake River System and provide a strategy for system operation. SOR started as a comprehensive, long-term study to review system operations of Federal water resource projects on the Columbia River and its tributaries in view of present and future needs of all users. The study included a technical, social, economic, and environmental analysis of alternatives for operation of the FCRPS, and an environmental analysis needed for Federal agencies to renew the Pacific Northwest Coordination Agreement (PNCA). The scope of the review included 14 major Federal projects on the Columbia River and its tributaries (12 operated by the Corps, 2 operated by BOR).

With the ESA listings of Snake River sockeye and chinook stocks in 1991 and 1992, the SOR took on a different character. It began to focus on the role that system operations could play in salmon recovery and NMFS became a key player (because of its responsibility under the ESA for determining the biological consequences of river operations).

Ten functional work groups and four analysis groups conducted work on the SOR. The functional work groups evaluated the impacts of system operation alternatives under consideration for the particular functional area represented by each work group. For example, the anadromous fish work group evaluated the alternatives to determine impacts on anadromous fish, and the water quality work group focused on water quality. Representation on each of the work groups included staff from each of the three lead Federal agencies, in addition to the states, other Federal agencies, utility and other interest groups, the tribes, and the general public.

The analysis groups examined the alternatives from a broader perspective. The River Operation Simulation Experts used computer models to determine flows and evaluations for each of the 90 alternatives for further evaluation of impacts by the technical work groups. The Economics Group analyzed direct and indirect economic impacts of the alternatives during full-scale analysis. The NEPA group guided preparation of the draft and final EIS to document all aspects of the review. The fourth group, PNCA Alternatives, was concerned with alternative forms of coordination for power.

The Draft EIS for SOR was issued in July 1994. It contained seven alternative System Operating Strategies (SOS):

SOS 1: Pre-ESA Operation—base case strategy without various measures resulting from ESA listings of anadromous fish; operations directed at power production and flood control satisfies traditional nonpower requirements at projects.

SOS 2: Current Operations—current system operations, including efforts to provide additional anadromous fish flows; flow augmentation of up to 370,200 hectare-meters (3 million acre-feet), in addition to the Water Budget; supplemental drafts from the Dworshak reservoir; flood control space shifted from the Snake River Basin to Grand Coulee Dam; lower Snake River projects near MOP levels; John Day at minimum irrigation pool level.

SOS 3: Flow Augmentation—year-round flow targets for minimum flows at Dworshak and mid-Columbia flow targets based on runoff forecasts above Grand Coulee.

SOS 4: Stable Storage Project Operation—year-round monthly elevation targets at storage projects; operations based on integrated rule curves at Libby and Hungry Horse Dams.

SOS 5: Natural River Operation—lower Snake drawdowns to natural river level; flow augmentation of up to 370,200 hectare-meters (3 million acre-feet) and Water Budget from mid-Columbia River; John Day at MOP during spring and summer; Dworshak at flood control levels.

SOS 6: Fixed Drawdown—lower Snake drawdown to spillway crest level; flow augmentation of up to 370,200 hectare-meters (3 million acre-feet) and Water Budget from mid-Columbia River; John Day at MOP during spring and summer; Dworshak at flood control levels.

SOS 7: Federal Resource Agency Operations—Alternative incorporated the operations suggested by USFWS and NMFS.

While the SOR agencies were finishing the Draft EIS in spring 1994, the U.S. District Court issued its ruling in *IDFG v. NMFS* that the 1993 Biological Opinion had failed to meet the necessary legal standard. A key issue in this lawsuit was whether enough water in the Columbia River System had been dedicated to salmon recovery and whether the new Biological Opinion must incorporate more water for fish into operations. Shortly after the *IDFG v. NMFS* ruling, the 9th Circuit Court of Appeals issued a ruling in another case, which said that the Northwest Power Planning Council (NPPC) had not given proper consideration to the recommendations of state resource agencies and tribes in preparing its Fish and Wildlife Program. Many people interpreted this decision to mean that state agency and tribal proposals should be given more weight in the operating decision. It became clear to the Federal operating agencies that the SOS that came out of SOR would need to take these legal decisions into account. In March 1995, NMFS issued its biological opinion on hydrosystem operations. Two additional decisions in lawsuits pertaining to fish operations were issued in June 1995; these decisions recognized the 1995 Biological Opinion as the guideline for operating the hydrosystem in light of the ESA.

From these events and activities, the alternatives for the Final EIS evolved. Those alternatives, as modified from the Draft EIS, were:

SOS 1a: Pre-Salmon Summit Operation—represents operations as they existed from 1983 to 1991 and includes the original Water Budget.

SOS 1b: Optimum Load-Following Operation—represents operations as they existed prior to changes resulting from the Northwest Power Act.

SOS 2c: Current Operations/No Action—represents an operation consistent with the Corp's 1993 Supplemental EIS; it includes up to 52,700 hectare-meters (427 thousand acre-feet) of additional water from above Brownlee Dam to improve fish flows.

SOS 2d: 1994-98 Biological Opinion (NEW)—matches the hydro operations contained in the 1994 to 98 Biological Opinion issued by NMFS in mid-1994.

SOS 3: (DELETED)

SOS 4c: Stable Storage Project Operation (REVISED)—applies integrated rule curves developed by Montana at Libby and Hungry Horse year-round; Dworshak and Albeni Falls are operated to specific elevations; Grand Coulee is also operated to specific elevations to provide acceptable water retention times; Grand Coulee flood central rule curves are applied only when the January-July forecast is greater than 8,400,000 hectare-meters (68 million acre-feet).

SOS 5b: Natural River Operation—draws down the lower Snake River facilities from April 16 through August 31 each year.

SOS 5c: Permanent Natural River Operation (NEW)—assumes the drawdown occurs year-round with no refill of the facilities to normal operating ranges.

SOS 6b: Fixed Drawdown Operation—draws down all four lower Snake River facilities for four and one-half months.

SOS 6d: Lower Granite Drawdown Operation—draws down only Lower Granite facility for four and one-half months.

SOS 7: (REPLACED WITH NEW ALTERNATIVES)

SOS 9a: Detailed Fishery Operating Plan—establishes flow targets at The Dalles, based on the previous year's end-of-year storage content; specific volumes of water are released from Dworshak and Brownlee, and lower Snake River facilities are drawn down to near spillway crest level for four and one-half months; specific spill percentages are established at run-of-river projects; spill caps are used to prevent excessive total dissolved gas; fish transportation is assumed to be eliminated.

SOS 9b: Adaptive Management—establishes fixed flow targets at McNary and Lower Granite Dams from April through July.

SOS 9c: Balanced Impacts Operation—establishes higher fixed flow targets, compared to SOS9b, at McNary and Lower Granite Dams.

SOS PA: Preferred Alternative (NEW)—spring and summer flow targets for the Snake and Columbia Rivers; refill to flood control levels by early spring; summer draft limits at storage reservoirs; Kootenai River white sturgeon operation; drawdown to MOP levels; increased spill levels limited by dissolved gas.

A final EIS for the SOR was completed in November 1995 (BPA, 1995). The preferred alternative included the following provisions:

- Spring and summer flow targets for the Snake and Columbia Rivers
- Refill to flood control levels by early spring
- Summer draft limits at storage reservoirs
- Kootenai River white sturgeon operation
- Drawdown to MOP levels
- Increased spill levels limited by dissolved gas.

The Corps signed the SOR ROD selecting the Preferred Alternative in February 1997.

3.22 Memorandum of Agreement for BPA Funding (System Configuration Team)

On September 16, 1996, five federal agencies involved in salmon and other fish and wildlife restoration activities in the Columbia River Basin signed a Memorandum of Agreement (MOA) to maintain BPA funding for Columbia Basin fish and wildlife activities at an average of $435 million

per year for fiscal years 1996 through 2001. Regional efforts to rebuild fish and wildlife resources affected by development of the hydropower system have been funded by several sources, including BPA rate payers and various Corps appropriations. The MOA represents an effort to balance the dramatically escalating costs of fish and wildlife restoration with the need to provide BPA with a degree of financial stability in a competitive energy market. Signers of the MOA represented the Department of the Army (for the Corps), the Department of Energy (for BPA), the Department of Interior (for USFWS and BOR) and the Commerce Department (for NMFS).

3.23 Lower Snake River Juvenile Salmon Migration Feasibility Study

The current study is one of several studies under Phase II of the SCS (see Section 3.4). It was initiated in 1994 to evaluate the technical, environmental, social, and economic effects of potential modifications to the configuration of four projects on the lower Snake River in order to increase the survival of juvenile anadromous fish as they migrate through the project areas, as directed by the NMFS 1995 Biological Opinion.

The current study includes engineering work; biological investigation (i.e., effects to salmon and steelhead, resident fish, and wildlife); effects on recreation, cultural resources, and water quality; and socioeconomic effects, including implementation costs, navigation, irrigation, and power. Also included is the development of an EIS and public involvement, both of which are essential to the NEPA process.

The initial pathways being evaluated in the study included: 1) the existing system, 2) major system improvements, and 3) natural river drawdown.

In an Interim Status Report issued in December 1996 (as directed by the NMFS 1995 Biological Opinion), the Corps stated the following:

> *Findings, based on the consideration of all data, indicate that there is insufficient information at this time for the Corps to make a recommendation on the best configuration of the hydropower system to safely pass juvenile salmon in the lower Snake River. However, preliminary conclusions on the drawdown options indicate that seasonal spillway crest and seasonal natural river should be eliminated from further consideration. Consequently, the Corps recommends the continuing investigation of three courses of action to improve salmon migration: permanent drawdown to natural river, surface bypass/collection, and the current fish programs, as well as combinations of the three.*

These, then, were developed into the four alternatives that were evaluated in the Final FR/EIS:

- Alternative 1—Existing System—under current operations, as directed by the 1995 biological opinion, ocean-going juvenile salmon pass the dams through turbines, fish bypass systems, or over the spillways. In accordance with the biological opinion issued by the NMFS, the Corps also implements flow augmentation and increased spill measures to assist migration. Screens are used to guide most fish away from turbines and into a bypass system. The young salmon are then routed back to the river or to a holding area for transport downriver by barge or truck. This system is constantly being evaluated and improved by scientists and engineers. Ongoing improvements include longer screens, additional barges, and flow deflectors on spillways.

- Alternative 2—Maximum Transport of Juvenile Salmon—This alternative would include all of the existing or planned structural and operational configurations from Alternative 1—Existing Conditions. However, this alternative assumes that the juvenile fishway systems would be operated to maximize fish transport from Lower Granite, Little Goose, and Lower Monumental and that voluntary spill would not be used to bypass fish through the spillways (except at Ice Harbor). To accommodate this maximization of transport some measures would be taken to upgrade and improve fish handling facilities.

- Alternative 3—Major System Improvements—These improvements would include construction of surface bypass collection systems (fish bypass systems that divert fish beginning at a more shallow level than current systems), fish guidance improvements, turbine modifications, structural changes to reduce harmful dissolved gas levels, and possible operational changes such as modifying river flows and spills. This could include improvements to the juvenile fish transportation system or in-river juvenile migration. An adaptive migration strategy would be used to provide flexibility for utilizing either in-river or transportation approaches.

- Alternative 4—Dam Breaching—Existing reservoirs would be permanently lowered to a natural free-flowing condition by removing a section of each dam, creating a 225-kilometer (140-mile) near-natural river. This would eliminate existing reservoir-related and dam passage mortality as well as speed the downriver migration of juvenile salmon. Commercial navigation and hydropower production would cease. Irrigation and recreation opportunities would be affected.

3.24 Plan for Analyzing and Testing Hypotheses

In 1993, fishery modelers from NMFS, BPA, NPPC, the Corps, Washington, Oregon, Idaho, and the Columbia River Inter Tribal Fish Commission formed the Analytical Coordination Work Group (ANCOOR). The objective of this work group is to compare and enhance smolt passage survival and lifecycle models used within the region for salmon management evaluation. Previous model comparison and peer-review efforts demonstrated that each smolt passage survival and lifecycle modeling system has differences in basic assumptions regarding the effects of recent and potential management actions. In 1994, a Scientific Review Panel was convened to provide technical oversight to ANCOOR. The Panel concluded that there were three major differences between the modeling systems:

- The distribution of survival over the life span
- The effect of flow on survival
- The benefit of smolt transportation.

The panel believed that as long as these differences exist, the models would output different answers in a predictable manner, rendering further analysis of model structure, behavior, and usefulness a relatively unproductive activity. The panel recommended focusing on describing and resolving the fundamental divergences through hypothesis testing. This hypothesis testing process became the Plan for Analyzing and Testing Hypotheses (PATH).

3.24.1 Objectives

- Determine the level of support for key hypotheses based on existing information, and provide guidance to management agencies on the implications of these analyses for key management decisions (retrospective analyses). Propose other hypotheses and/or model improvement that are more consistent with the data.
- Assess the effects of alternative future management actions on salmon stocks, and the ability to distinguish among competing hypotheses from future information (prospective analyses). Advise various institutions (i.e., NMFS, NPPC, BPA, USFWS) on the consequences of alternative future management actions for salmon stocks, and the types of research, monitoring, and adaptive management experiments that could maximize the rate of learning and clarify decisions.

3.24.2 Process

Iteration within the PATH process occurs as this logical framework is revised over time in response to improvements in information and analytical methods, as well as changing management questions. The framework is intended to provide guidance to the development of regional programs that would stabilize, ensure persistence, and eventually restore depressed salmon stocks to self-sustaining levels. It is also meant to provide a structure for an adaptive learning approach to development and implementation of a regional salmonid recovery program. The PATH process takes a whole lifecycle approach to developing this framework to encompass potential delayed effects of stressors or processes in one life stage on subsequent life stages.

3.25 Federal Caucus

To better coordinate the Federal response to, and recovery of, ESA-listed fish species in the Columbia River Basin, the Federal Caucus was developed. The caucus consists of nine agencies with different authorities and jurisdictions:

- National Marine Fisheries Service
- US Fish and Wildlife Service
- Bonneville Power Administration
- US Army Corps of Engineers
- US Bureau of Reclamation
- Environmental Protection Agency
- US Forest Service
- Bureau of Land Management
- Bureau of Indian Affairs.

The Federal Caucus released the *Final Basinwide Salmon Recovery Strategy* on December 21, 2000. The final strategy followed the preparation of two draft documents including the *Conceptual Recovery Plan* or "All-H Paper" in December 1999 and 15 public joint hearings that also considered the Draft EIS for the Corps' Lower Snake River Juvenile Salmon Migration Feasibility Study (this document). The strategy includes seven goals:

- Conserve Species
- Conserve Ecosystems
- Assure Tribal Fishing Rights and Provide Non-Tribal Fishing Opportunities

- Balance the Needs of Other Species
- Minimize Adverse Effects on Humans
- Protect Historic Properties
- Preserve Resources Important to Maintaining Traditional Tribal Culture.

The strategy includes actions within each of the H's (habitat, hydropower, hatcheries, and harvest) that can be taken to improve survival at every lifestage. The Federal Caucus strategy complements the CRBFWP by the NPPC and supports a subbasin and watershed approach to planning and implementing projects. However, the Federal Caucus strategy is necessarily broader in scope than the CRBFWP because it proposes actions that could be taken outside the hydropower system (e.g., agriculture, forestry, industry, and municipalities) using existing authority (e.g., permitting, Clean Water Act compliance).

3.26 State Plans for Salmon Recovery

The states of Oregon and Washington have both developed and implemented programs for the recovery of listed salmon in state waters. The *Oregon Plan* was approved by voters in November 1998 and targeted for recovery of coastal stocks of salmon and steelhead. Shortly thereafter, in January 1999, Governor Kitzhaber expanded the scope of the plan to include salmon and steelhead throughout the state. Similarly, the State of Washington released the *Statewide Strategy to Recover Salmon, "Extinction is Not An Option"* in September 1999.

The Oregon Plan and Washington's Statewide Strategy have many similar components and objectives including:

- **Water Quality**—Revision of state-wide water quality standards and implementation of Total Maximum Daily Loads (TMDLs), where appropriate
- **Water Quantity**—Investigation and prioritization of instream flow for fish
- **Habitat**—Funding for estuarine, stream, and riparian restoration, preservation, and enhancement
- **Fish Passage Barriers**—Identification and prioritization for correcting passage barriers, particularly related to culverts
- **Harvest and Hatchery Management**—Marking all hatchery fish; investigating selective fishing methods; and increasing scrutiny of hatchery practices and production levels
- **Forest Practices**—Review and revision of Forest Practices Rules
- **Public Outreach**—Programs to inform citizens how they can contribute to the restoration, conservation, and enhancement of salmon habitat including potential homeowner effects on water quality and water quantity
- **Research, Monitoring, and Assessment**—Funding and implementation of state programs, coordination with regional efforts, incorporation of adaptive management, and plan reviews by independent science panels.

Some of the programs included in the Oregon Plan and Washington's Statewide Strategy are new, while others expand or refocus existing programs. A major theme to the Oregon and Washington State sponsored plans is that each provides an explicit science-based approach focused on responding to legal requirements and recovering listed salmon species.

In contrast to Washington and Oregon, Idaho does not currently have a recovery plan developed especially for listed salmon. However, Idaho has recently (May 2000) created the Office for Species Conservation, which is focused on addressing issues concerning ESA listed or potentially listed fish and wildlife species throughout the state and presenting a unified Idaho perspective to Federal agencies about these issues. All of the states participate in regional processes such as the NPPC and the CRBFWP and provide comment on federal recovery documents such as biological opinions on the FCRPS ongoing operation and maintenance activities.

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5. Glossary

Anadromous fish: Fish, such as salmon or steelhead trout, that hatch in fresh water, migrate to and mature in the ocean, and return to fresh water as adults to spawn.

Biological Opinion: A formal opinion/evaluation issued by a federal or state agency responsible for monitoring endangered or threatened wildlife. A preliminary assessment is often issued in response to an intra-agency request for information regarding species status and is designed to be incorporated into a biological opinion.

Bypass system channel: Fish diverted from turbine passage are directed through a bypass channel to a holding area for release or loading onto juvenile fish transportation barges or trucks.

Collection channel: Holding area within the powerhouse that fish enter after exiting the bulkhead slot.

Dissolved gas supersaturation: Caused when water passing through a dam's spillway carries trapped air deep into the waters of the plunge pool, increasing pressure and causing the air to dissolve into the water. Deep in the pool, the water is "supersaturated" with dissolved gas compared to the conditions at the water's surface.

Drawdown: In the context of this FR/EIS, drawdown means returning the lower Snake River to its natural, free-flowing condition via dam breaching.

Endangered species: A native species found by the Secretary of the Interior to be threatened with extinction.

Gatewell basket: A mechanical dipping basket used to remove fish from powerhouse gatewells.

Minimum operating pool (MOP): The bottom one foot of the operating range for each reservoir. The reservoirs normally have a 3-foot to 5-foot operating range.

Record of decision (ROD): A document, based on information disclosed in the Final Environmental Impact Statement, that identifies the alternative chosen, mitigation and monitoring measures to be implemented, and other information relative to the decision.

Resident fish: Fish species that reside in fresh water throughout their lifecycle.

Sanctuary dipnet: Another term for sanctuary bag, a 50-pound bag placed on the bottom of a gatewell basket. It retains fish placed in gatewell baskets pending their release into a tank truck.

Spill: Water released through the dam spillways, rather than through the turbines. Involuntary spill occurs when reservoirs are full and flows exceed the capacity of the powerhouse or power output needs. Voluntary spill is one method used to pass juvenile fish without danger of turbine passage.

Spillway flow deflectors (flip lips): Structures that limit the plunge depth of water over the dam spillway, producing a less forceful, more horizontal spill. These structures reduce the amount of dissolved gas trapped in the spilled water.

Stilling basin: A concrete-lined pool below a dam. Water passing through spillways generates tremendous energy that must be dissipated. This is accomplished by allowing the water to fall over the spillway into the stilling basin.

Surface bypass collector (SBC) system: System designed to divert fish at the surface before they have to dive and encounter the existing turbine intake screens. SBCs direct the juvenile fish into the forebay, where they are passed downstream either through the dam spillway or via the juvenile fish transportation system of barges and trucks.

Threatened species: A native species likely to become endangered within the foreseeable future.

Annex A

NPPC Fish and Wildlife Program

Details of Phase II Amendments Related to Mainstem Survival

(Source: NPPC, 1991)

Keypoints of ISG Report

(Source: ISG, 1996)

Note: This excerpt is reproduced directly from the Amendments to the Columbia River Basin Fish and Wildlife Program (Phase II) (NPPC 1991).

Details of Phase II Amendments Related to Mainstem Survival

Because of their focus on fish survival during migration in the mainstems of the Columbia and Snake Rivers, Phase II amendments have been of key concern to Federal agencies with management responsibility for dams on these rivers (Corps, BPA, BOR). Following are highlights of key measures in Phase II that relate to mainstem survival in the Columbia River basin, with an emphasis on the lower Snake River.

Mainstem Survival

Salmon and steelhead migrate to and from the sea, and their safe passage is critical. Several factors affect passage. Dams present physical barriers; the slower water in reservoirs impedes travel time; and the fish encounter predators. NPPC adopted the measure below to address these problems for both juvenile fish migrating downstream and adult fish moving back upstream. To enhance river operations, the NPPC established a Fish Operations Executive Committee made up of senior management representatives of NPPC, fishery managers and river operators to meet annually to develop an Implementation Plan that will be carried out by the Fish Passage Center. The Plan will address flows, spill, transportation, other agency plans, coordinated system operations, research and monitoring efforts and other mainstem passage matters. The following measures are designed to increase survival for salmon migrating in the rivers and for fish transported in barges.

Screens and bypass system at dams

- Completion of screens and juvenile bypass systems at all eight federal dams on the mainstem of the Columbia and Snake Rivers by 1998.
- Installation of longer screens to guide more fish away from turbines and evaluation of modifications that may be needed to accommodate reservoir drawdown measures.
- Expedited improvements at Bonneville Dam's second powerhouse, where screens have performed poorly since the powerhouse began operation in 1983. Also, expedited evaluation of fish guidance problems at Bonneville Dam's first powerhouse.

Reduction of predation

- Design and operation of bypass system outfalls to reduce predation by both fish and birds, as well as continued exploration of new fish bypass technologies.
- A 20 percent reduction of the squawfish population annually.
- Continued evaluation of the interaction between marine mammals and salmon.

Transportation of fish around dams

Moving fish in barges or trucks benefits some fish but remains controversial. Transportation decisions are made by the fish managers in cooperation with the Corps which owns and operates the trucks and barges. Transportation is called for when fish survival is expected to be greater with transportation, usually in low water years. Substantial improvements to make transportation safer and more effective are also called for.

Increased river velocities to enhance travel time

Fish survival increases as travel time decreases, but there is little consensus on the effectiveness of individual measures. NPPC believes it would be a serious mistake to use lack of consensus as a reason to take no action, especially in light of the serious state of certain runs. None of the new measures below will violate flood control limits or the Vernita Bar agreement that protects the spawning area for upriver bright fall chinook in the Hanford Reach of the Columbia River. NPPC also has given the power system flexibility on how it acts to increase storage to shape flows for fish. Immediate measures call for:

- Increased flows in the Snake River during the spring migration aimed at providing a flow equivalent of at least 85,000 cubic feet per second by lowering Snake River pools to near minimum operating level and providing additional water out of Dworshak Dam.

- Deeper drawdowns of lower Snake River reservoirs by 1995 also have been called for because the immediate measures do not appear to be enough in themselves to rebuild some of the runs. These deeper drawdowns will be implemented unless they are found to be economically or structurally infeasible, biologically imprudent, or inconsistent with the Northwest Power Act. Operations, design, mitigation, and biological plans for reservoir drawdowns are due in 1993. The measure allows for full participation by the river interest groups in development of drawdown plans and provides for independent analysis.

- Operation of Brownlee reservoir by Idaho Power Company so upper Snake River Basin water is passed to assist migrants and shifting system flood control storage from Brownlee to other Columbia projects in years when below average runoffs is forecast.

- Study of the potential for new storage in the Snake River Basin to provide additional water and a study to assess effects of changes in water quality on salmon and steelhead, as well as a regional assessment of water availability.

- Water efficiency improvements, water conservation, improved forecasting, water marketing, dry year option leasing, storage buy-backs and other measures to secure substantial additional Snake River water for spring migrants.

- Increased flows in the Columbia that aim to provide at least 200,000 cubic feet per second in the lowest water years with even higher flows in slightly better years.

- To evaluate benefits for Columbia summer migrants in low water years, provision of water from U.S. non-treaty storage and continued search for energy exchanges and other alternatives to make water available to fish.

- Due to uncertainty over the availability of out-of-region power, a call to the BPA to begin to secure options for more resources to ensure more flows for fish.
- A call to evaluate various options that could meet winter peaking needs and other power system changes that could make more water available for fish flows and reduce the impacts on the power system.

State Actions

- A call for states to conduct water availability studies, establish minimum instream flow levels, deny new water appropriations that would harm anadromous fish, and acquire water rights on a voluntary basis to improve fish flows.
- Improved enforcement of water rights at diversions, including measuring devices.

Adult fish returning to spawn

- Evaluation of the effectiveness of releasing cool water in late summer from Dworshak and Hells Canyon dams to lower water temperatures to benefit returning fall chinook and steelhead.
- Leaving bypass screens in place longer if necessary to prevent adult fish from falling back through the turbines.
- Improvements in adult ladders and operating criteria.
- Evaluation of the growing shad population to determine if it is clogging ladders and impeding adult salmon passage.
- Evaluation of video counting and monitoring adult passage with internal (PIT) tags.
- Assessment of using cool water in ladders and evaluation of the effects of zero nighttime flows on adult salmon in the lower Snake.

Note: This excerpt is reproduced directly from Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem. (ISG 1996).

Key Points of ISG Report

Conceptual Foundations in the Current Fish and Wildlife Program

As the ISG began development of a conceptual foundation, it looked first to the Columbia River Basin Fish and Wildlife Program to determine whether such a foundation already exists in that document. Our answer is yes and no. The Fish and Wildlife Program actually has several implied conceptual foundations. This is likely a result of the process through which it is created, in which recommendations from fish and wildlife managers and others are reviewed and adopted. Each participating agency or individual brings to the process some version of a conceptual foundation on which their recommendations are based. In nearly every instance, these conceptual foundations are not stated outright, but are only implied. In some cases, the foundations that make their way into the program through the adoption of specific measures are in conflict.

In the review of the Fish and Wildlife Program, the ISG analyzed the general assumptions that seem to determine the direction of program activities. The most fundamental assumption appears to be that the natural ecological processes that result in a healthy salmon population can be, to a large degree, circumvented, simplified and controlled by humans. Out of this context, the ISG drew three further assumptions.

1. The number of adult salmon made available to spawn is primarily a direct response to the number of smolts produced. (More young fish will automatically result in more adult spawners.)
2. Salmon production can be increased by actions taken within the river without accounting for conditions in the estuary or ocean.
3. Management actions will not compromise environmental attributes of the ecosystem that supports salmon.

These assumptions drive management toward actions that are best characterized as technological substitutes for ecological processes. They are often measures that respond to individual problems and they may be credible scientific approaches to those problems if they are reviewed in isolation: hatcheries and mechanisms for improving salmon survival at hydroelectric projects, for example, rather than actions that look at the broader context of salmon life history, behavior, and habitat. They reflect a good faith effort by the NPPC and the region's fisheries managers to recover salmon populations. However, the continuing decline of the basin's salmon populations indicates that the conceptual foundations in the current fish and wildlife programs and the actions based on those foundations are inadequate.

ISG Proposed Conceptual Foundation

The conceptual foundation the ISG proposes departs from some of those in the current program. It is not intended to validate measures in the program, nor does it derive out of those measures. It is instead designed to form a framework into which recovery measures can be integrated, when they

are appropriate. It can provide a template against which recovery actions can be measured and evaluated.

In this proposed conceptual foundation, we treat the Columbia River and its tributaries as both a natural *and* a cultural system. A natural-cultural ecosystem encompasses all the ecological and social processes that link organisms, including humans, with their environments. This approach integrates the habitat of salmon and other wildlife, as well as human habitat, with land use and other cultural developments.

We draw our conceptual foundation from established ecological principles, based on what we understand about the decline of salmon populations and their habitat in the Columbia River Basin.

There are three critical elements of the conceptual foundation:

1. Restorations of Columbia River salmon must address the entire natural and cultural ecosystem, which encompasses the continuum of freshwater, estuarine and ocean habitats where salmon complete their life histories. This consideration includes human developments, as well as natural habitats.
2. Sustained salmon productivity requires a network of complex and interconnected habitats, which are created, altered, and maintained by natural physical processes in freshwater, the estuary, and the ocean. These diverse and high-quality habitats are crucial for salmon spawning, rearing, migration, maintenance of food webs and predator avoidance.
3. Life history diversity, genetic diversity, and metapopulation organization are ways salmon adapt to their complex and connected habitats. This biodiversity and its organization contribute to the ability of salmon to cope with the environmental variation that is typical of freshwater and saltwater environments.

The Natural-Cultural Ecosystem

We believe an ecosystem with a mix of natural and cultural features can still sustain a broad diversity of salmon populations in the Columbia River Basin. We call this ecosystem "normative," by which we mean an ecosystem where specific functional norms or standards that are essential to maintain diverse and productive populations are provided. In developing our definition of normative, we looked at what conditions lead to high levels of salmon productivity in less-constrained river systems, as well as in the historic Columbia River Basin.

Key among the conditions we define as normative is the availability of a continuum of high-quality habitat throughout the salmon life-cycle, from freshwater streams along the entire migratory path into and back out of the Pacific Ocean. This habitat varies from freshwater to saltwater, from fast-moving, gravel-bottom streams to deep pools and deeper seas. We assume that this habitat is dynamic, responding to daily, seasonal, annual or longer life-cycle changes. We also assume that a diverse array of salmon populations and other occupants of this habitat have adapted over time to the majority of these natural changes. Under some circumstances, salmon in mainstem reaches and adjacent subbasins of the Columbia formed groups of interconnected populations, which we refer to as metapopulations.

Development of the Columbia River for hydropower, irrigation, navigation, and other purposes has led to a reduction in both the quantity and quality of salmon habitat, and most critical, a disruption in

the continuum of that habitat. Depleted salmon populations cannot rebuild if any habitat that is critical during any of their life stages is seriously compromised.

Consequently, we believe that the most promising way to help salmon populations rebuild is to reduce or remove conditions that limit the restoration of high-quality salmon habitat at each of their life history stages. Our intent in describing a normative ecosystem for salmon is to point our key characteristics that are critical to their survival and productivity. Our description is necessarily general. Specific prescriptions, such as flow regimes, levels of stock diversity, etc., will need to be developed through a process that includes policy development and trade-offs between the natural and cultural elements of the ecosystem. The normative ecosystem is also dynamic. Conditions in the normative ecosystem will vary, progressing from the current state of the river toward historic conditions, based on the region's decisions and actions.

Productivity and the Network of Habitats

The Columbia River is a complex network of habitat types from the headwaters to the estuary. Populations of salmon, as well as other fauna and flora, are distributed throughout this network, thriving wherever there are sufficient resources to sustain their growth and reproduction. Some species are relatively localized, finding adequate resources within a narrow geographic range. These include resident fish. Others, such as anadromous salmon, require vast migrations and specific conditions at each "post" in those migrations, if they are to thrive.

The system of hydropower dams on the Columbia has greatly diminished the diversity of habitat once characteristic of this watershed. The dams severed the continuum of habitat, leaving very little riverine habitat left in the mainstem and isolating other types of habitat. Dams also altered flooding and draining patterns, which further reduced available habitat types and food webs in those habitats. Two key consequences of this loss of habitat diversity have been a reduction in the biodiversity of native salmon stocks and the proliferation of non-native species. Certain species have been able to adapt to conditions created by the dams, while others have not. For example, invertebrates, fish and plants that are not native to the Columbia have proliferated in the impounded river reaches rather than in free-flowing reaches, generally because impounded habitat is more homogeneous.

Normative river conditions are re-expressed at some distance downstream from dams—the further from the dam, the more habitat recovery occurs. This has been demonstrated on the Flathead and Clearwater Rivers, for example. However, the mainstem dams on the Columbia and Snake Rivers, for the most part, preclude such resetting of habitat conditions because water released from each dam pours directly into the reservoir behind the next downstream dam. The exception is the Hanford Reach on the mid-Columbia, the last free-flowing stretch of the river. The Hanford Reach provides a model of the productivity possible in river reaches that are not fully regulated by dams. It supports a healthy population of fall chinook capable of surviving downstream migration, harvest in the ocean and return upstream to spawn.

Life History Diversity and Metapopulation Organization

In their 1996 review of the status of Pacific salmon, the National Research Council recommended that salmon be viewed as metapopulations rather than as isolated stocks. This application of metapopulation concepts to natural populations is still being debated among scientists, so our

inclusion of the metapopulation structure as it applies to salmon should be viewed as a hypothesis that requires further study and confirmation.

Metapopulations are groups of local populations that are linked by individuals that stray among the populations. Metapopulations persist through the mechanism of straying. When local populations become extinct, they can be re-established through colonization by strays from neighboring local populations. We believe that metapopulation structure is likely in salmon because these fish display both a high degree of homing to their natal streams, which establishes the groups of local populations, and a variable level of straying, which provides the dispersal of genetic traits needed to successfully recolonize habitat vacated by lost populations.

Studies indicate that the most abundant salmon spawning populations likely occurred in river segments with well-developed floodplains and gravel bars, where habitat complexity was high, including areas suitable to spawning, egg incubation, and juvenile rearing. We conclude that salmon populations spawning in large alluvial mainstem reaches of the Columbia may have served as core populations and, as such, may have played critical roles in sustaining salmonid populations in the basin.

Loss of prime mainstem spawning habitat for core populations, and further losses from fragmentation, isolation and degradation of habitats in tributary systems, could have significantly reduced the long-term persistence and stability of regional salmon production. For example, most fall chinook that spawned in the mainstem Columbia and Snake Rivers are now extinct.

One of the only surviving mainstem populations and fall chinook spawns is in the Hanford Reach in the mid-Columbia. This is the largest naturally spawning population of chinook salmon above Bonneville Dam, and it has been stable during the years when salmon in other parts of the basin have undergone severe decline. It is possible that fall chinook in the Hanford Reach now function as a core population, which might serve as a source for colonization of adjacent habitats if normative conditions were restored in those areas.

Isolated population of salmon are less likely to be recolonized should they be driven toward extinction because they may lack adjacent populations with similar genetic traits. For the same reason, surviving isolated populations also have less likelihood of successfully contributing to efforts to replenish declining populations elsewhere in the basin. As populations become isolated, local extinctions become permanent, and the entire metapopulation moves toward extinction. Therefore, we believe that restoring salmon populations in this basin will require both the restoration of more diverse habitat conditions and the reconnecting of habitats into the continuum necessary to support salmonids at every stage of their life histories. If this continuum can be restored, we believe that metapopulations will re-emerge to help stabilize regional salmon populations against environmental fluctuations.

Assessment of the Fish and Wildlife Program

In its review of the scientific basis of the Fish and Wildlife Program, the ISG assigned a qualitative rating that summarized its assessment of the scientific support for various assumptions. Its numeric rating ranked assumptions and principles based on what we deem the "level of proof." "Level one" would apply to an assumption for which there is solid peer-reviewed empirical evidence. "Level two" would be backed by strong evidence, but not conclusive evidence. "Level three" assumptions

have theoretical support with some evidence. "Level four" assumptions are speculative, with little empirical evidence to support them. Finally, "level five" assumptions are contradicted by good evidence to the contrary. Chapters 4 through 10 contain our analysis of the data we reviewed to establish these conclusions.

The ISG first reviewed three general principles that appear in both the NPPC's program and in the Northwest Power Act.

1. *The salmon bearing ecosystem in the Pacific Northwest and northeast Pacific Ocean has considerable excess carrying capacity.* Level of proof: four. This assumption leads to the further assumption that there is a simple relationship between the numbers of smolts and increasing overall productivity over the long term. What confounds this assumption is the complexity of both freshwater and marine conditions. In-river, estuary, and ocean environments fluctuate dramatically in response to both human-caused and environmental changes. The key to resilience in a variable environment is not just the numbers of smolts nor the quantity; it is the diversity of both habitat and genetic traits that is critical to restoring Columbia Basin salmon.
2. *Abundance of salmon and steelhead in the Columbia River Basin has, to a significant degree, declined due to, and is presently limited by, human actions.* Level of proof: one. This assumption is irrefutable. Even accounting for natural variation in the environment, decline of most species has closely paralleled the development of the basin. Damage from early and ongoing development has removed substantial portions of the basin from access by salmon, altered remaining habitat, reduced the abundance of salmon and decreased the ability of surviving salmon populations to cope with natural environmental variations. Focusing only on hydropower impacts severely constrains the region's ability to reverse these trends.
3. *Ecosystem functions lost as a result of development of the Columbia River can be replaced by technological solutions to individual problems.* Level of proof: four. The best evidence against this assumption is the continuing decline of the basin's salmon populations. While technology will continue to be part of any restoration effort in the Columbia River, the ISG recommends that the region move from a strategy of "fixing" ecosystem damage to one that places greater reliance on re-expression of the natural biological and physical processes of the Columbia River salmon-bearing ecosystem.

The ISG also analyzed 29 specific assumptions contained in the Fish and Wildlife Program, assigned a numeric ranking to each, and provide in Chapter 3 a brief overview of the science supporting our ranking. In Chapters 4 through 10, we expand on this evidence.

General and Specific Conclusions Related to Mainstem Survival

As the ISG noted, restoration of Columbia River Basin salmon populations will require a new definition and understanding of the salmon ecosystem. Humans have transformed the Columbia River Basin from a thriving natural environment to a great hydroelectric, irrigation, and transportation system, one that drives this region's economy. The human approach to salmon recovery has reflected these impressive technological accomplishments: hatcheries have attempted to replace natural productivity, flow augmentation has attempted to replace the spring freshet, barge transportation has attempted to replace inriver migration, and so on. To reverse the decline of salmon populations, we believe the region must endorse a conceptual foundation for salmon recovery, such as the one previously described, and base its efforts on that foundation.

The key to salmon productivity in the future will be the degree to which normative ecosystem conditions are re-introduced into the Columbia River Basin. To accomplish this return to normative conditions, we recommend the following.

Recognize explicitly that salmon in the Columbia River Basin exist naturally as collections of locally adapted populations organized into aggregates of core and satellite populations known as metapopulations. To increase total productivity, management decisions should nurture life history and population diversity. That diversity will require protection for the remaining core populations, and restoration and reconnection of potential core habitats at strategic areas within the basin. The Hanford Reach, the last free-flowing stretch of the Columbia, could be a model for this management approach.

Protect and restore freshwater habitat for all life history stages, with a focus on key Columbia River and tributary reaches and lakes. This approach would include: restoration of the spring freshet to revitalize in-river habitats; stabilization of daily fluctuations in flows to allow food webs to persist in shallow-water habitats that are important juvenile rearing areas; provision of incentives for watershed planning that emphasized riparian and upland land-use activities to enhance instream and lake habitats. Wherever possible, reconnect restored tributary habitats to restored mainstem habitats, particularly where remnant core populations, such as the Hanford Reach fall chinook, exist.

Manage stocks with a more complete understanding of migratory behavior and the limitations that migratory behavior could place on river operations. From their review, the ISG concluded that the Columbia and Snake Rivers should not be treated merely as conduits through which young salmon passively migrate to the sea. On the contrary, the young fish have ecological requirements that must be met during their downstream migration through the mainstem habitat. Fishery managers need to better understand these needs and manage accordingly.

Reduce sources of mortality throughout the salmonid ecosystem, including the ocean and the estuary, as well as the rivers and tributaries of the Columbia River Basin.

Current and future salmon recovery measures should correspond to the normative ecosystem concept and be evaluated for their effectiveness in meeting stated objectives. For example, an approach whose goal is a normative ecosystem would highlight restoration of life history diversity, rather than more technological approaches, such as transporting fish in barges or producing them in hatcheries. Hatcheries and transportation should only be used selectively and experimentally, and they should be monitored carefully. The has attempted to replace as a whole needs an integrated ecosystem monitoring and evaluation program.

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Annex B

Summary of Proposed Snake River Salmon Recovery Plan Provisions Related to Mainstem Survival

(Source: NMFS, 1995b)

Note: The following is reproduced directly from the Proposed Recovery Plan for Snake River Salmon (NMFS 1995b)

Summary of Proposed Recovery Plan Provisions Related to Mainstem Survival

The goal of the Proposed Recovery Plan is to restore the health of the Columbia and Snake River ecosystem and to recover listed Snake River salmon stocks. Many of the recommended actions will directly benefit other species such as other salmon stocks, sturgeon, and bull trout. Implementation of the Proposed Recovery Plan should also conserve biodiversity, a factor that is essential to ecosystem integrity and stability. Many of the actions in the Proposed Recovery Plan have been used to formulate reasonable and prudent measures in current Section 7 consultations.

The Proposed Recovery Plan discusses the natural history and current status of Snake River salmon. It also addresses known and potential human impacts, and displays the costs directly attributable to recovery. In addition, the Proposed Recovery Plan identifies delisting criteria and biological objectives, and proposes the tasks required to meet them. Tasks are identified in the areas of institutional structure, tributary ecosystem, mainstem and estuarine ecosystem, harvest management, and artificial propagation.

NMFS' approach to Snake River salmon recovery places highest priority on ameliorating the primary factors for the species' decline and eliminating existing impediments to recovery. The Plan does this by proposing actions that offer immediate benefits, and refining those actions over time to ensure the most efficient use of limited resources. This strategy incorporates an adaptive management process; it allows actions to be added, deleted, or refined as important scientific information and analyses becomes available.

Mainstem Ecosystem

In the mainstem ecosystem, salmon face problems associated with their downstream and upstream migrations. The journey through the lower Snake and Columbia Rivers has become more hazardous since eight hydroelectric dams were built and their reservoirs created. Each dam delays juvenile fish in their transition to the ocean environment and exacts additional losses. Seventy percent of the 482 miles between the mouth of the Columbia River and Lewiston/Clarkston on the Snake River has been converted from free-flowing river into reservoirs. This change has slowed the rate of downstream travel for smolts and increased the amount of habitat favorable to predator species. Hatchery fish and exotic species compete with and prey on the listed salmon in the mainstem ecosystem.

NMFS examined various approaches to improving the downstream survival of juvenile Snake River salmon (as well as that of other fish that migrate through the corridor). The actions considered include improving in-river and dam passage conditions, improving collection and transportation systems for juvenile migrants (especially under adverse river conditions), and drawing down reservoirs.

NMFS proposes to proceed on a long-term adaptive management approach that will depend upon a combination of improved in-river migration conditions, improved transportation, and major structural changes at dams. The Proposed Recovery Plan recommends a major decision point when

sufficient adult survival information is available in 1999. In the interim, all necessary studies, planning, design, and environmental documentation for drawdowns should be completed. At the same time, in-river migration conditions should be improved to the maximum extent possible using techniques such as increased flows, increased spill, physical improvement of the dams, and aggressive surface bypass development and testing. Significant improvements should also be made in transportation operations. The overall approach is to proceed on a path that implements measures in the short term that are most likely to increase survival while at the same time enhancing our ability to isolate and address major causes of mortality in the future. Ultimately, the purpose of this approach is to determine whether there can be sufficient improvements to in-river survival and transportation to recover listed fish without major drawdowns. The listed and unlisted fish also need improvements in their upstream passage conditions. To accomplish this, the Proposed Recovery Plan prescribes actions such as installing extended length screens, operating turbines at peak efficiency for fish passage, extending the period during which the juvenile bypass system is in operation, implementing a dissolved gas abatement program, remedying water pollution problems, developing emergency auxiliary water supplies for adult fishways, and decreasing water temperatures.

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Final

Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

Appendix T

Clean Water Act, Section 404(b)(1) Evaluation

February 2002

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Final
Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

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Appendix T
Clean Water Act, Section 404(b)(1) Evaluation

Produced by

U.S. Army Corps of Engineers
Walla Walla District

February 2002

FOREWORD

Appendix T was prepared by the U.S. Army Corps of Engineers (Corps), Walla Walla District. This appendix is one part of the overall effort of the Corps to prepare the Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (FR/EIS).

The Corps has reached out to regional stakeholders (Federal agencies, tribes, states, local governmental entities, organizations, and individuals) during the development of the FR/EIS and appendices. This effort resulted in many of these regional stakeholders providing input and comments, and even drafting work products or portions of these documents. This regional input provided the Corps with an insight and perspective not found in previous processes. A great deal of this information was subsequently included in the FR/EIS and appendices; therefore, not all of the opinions and/or findings herein may reflect the official policy or position of the Corps.

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TABLE OF CONTENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
As	arsenic
ASTM	American Society for Testing and Materials
Ba	barium
BA	Biological Assessment
Be	beryllium
BGS	behavioral guidance structure
BOR	U.S. Bureau of Reclamation
BPA	Bonneville Power Administration
Co	cobalt
CoC	Chemicals of Concern
Comp Plan	Lower Snake River Fish and Wildlife Compensation Plan
Corps	U.S. Army Corps of Engineers
cy	cubic yard
Cr	chromium
Cu	copper
DDD	dichloro-diphenyl-dichloro-ethane
DDE	dichloro-diphenyl-dichloro-ethylene
DDT	dichloro-diphenyl-trichloro-ethane
DMEF	Dredged Material Evaluation Framework
DMMP/EIS	Dredged Material Management Plan and Environmental Impact Statement
DMMS	Dredged Material Management Study
DREW	Drawdown Regional Economic Workgroup
Ecology	Washington Department of Ecology
EDTA	ethylendiamine tetraacetic acid disodium salt
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESBS	extended submerged bar screen
FCRPS	Federal Columbia River Power System
Feasibility Study	Lower Snake River Juvenile Migration Feasibility Study
FR	Feasibility Report
FR/EIS	Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement
Guidelines	Clean Water Act, Section 404(b)(1) Guidelines
Hg	mercury
HMU	Habitat Management Unit
KAF	thousand acre feet
MAF	million acre feet
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
Mn	manganese

ACRONYMS AND ABBREVIATIONS

Mo	molybdenum
NEPA	National Environmental Policy Act
ng/L	nanograms per liter
Ni	nickel
NMFS	National Marine Fisheries Service
NRCC	National Resources Council Canada
NTU	Nephelometric Turbidity Unit
OHWM	Ordinary High Water Mark
PATH	Plan for Analyzing and Testing Hypotheses
Pb	lead
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo dioxins
PCDF	polychlorinated dibenzo furans
pH	parts hydronium
ppb	parts per billion
ppt	parts per trillion
QA/QC	quality assurance/quality control
RM	River Mile
RSW	removable spillway weir
SCS	System Configuration Study
SBC	surface bypass collector
Se	selenium
STS	submerged traveling screens
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorinated dibenzo furans
TDG	total dissolved gas
TEF	toxicity equivalence factor
TEQ	toxicity equivalence quantity
Tl	thallium
TP	total phosphorus
TPH	total petroleum hydrocarbons
TSS	total suspended solids
µg/kg	micrograms per kilogram
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
V	vanadium
WAC	Washington Administrative Code
Zn	zinc
ΔC	change in conductivity from background to observable

ENGLISH TO METRIC CONVERSION FACTORS

To Convert From	To	Multiply By
LENGTH CONVERSIONS:		
Inches	Millimeters	25.4
Feet	Meters	0.3048
Miles	Kilometers	1.6093
AREA CONVERSIONS:		
Acres	Hectares	0.4047
Acres	Square meters	4047
Square Miles	Square kilometers	2.590
VOLUME CONVERSIONS:		
Gallons	Cubic meters	0.003785
Cubic yards	Cubic meters	0.7646
Acre-feet	Hectare-meters	0.1234
Acre-feet	Cubic meters	1234
OTHER CONVERSIONS:		
Feet/mile	Meters/kilometer	0.1894
Tons	Kilograms	907.2
Tons/square mile	Kilograms/square kilometer	350.2703
Cubic feet/second	Cubic meters/sec	0.02832
Degrees Fahrenheit	Degrees Celsius	(Deg F –32) x (5/9)

UNIT DEFINITIONS

parts per million (ppm) ≅ mg/L
parts per billion (ppb) ≅ µg/L
parts per trillion (ppt) ≅ ng/L

Executive Summary

The U.S. Army Corps of Engineers (Corps), Walla Walla District, operates four lock and dam facilities on the lower Snake River. These include the Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Dams. In response to the National Marine Fisheries Service (NMFS) 1995 Biological Opinion concerning the operation of the Federal Columbia River Power System, the Corps evaluated structural and operational alternatives to improve the downstream migration of juvenile salmonids through the four lower Snake River dams. That effort resulted in the preparation of the Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (FR/EIS).

The purpose of the FR/EIS is to evaluate and screen structural alternative measures that may increase the survival of juvenile anadromous fish through the Lower Snake River Project and assist in the recovery of Endangered Species Act-listed salmon and steelhead stocks. The FR/EIS examined four alternatives: 1) Existing Conditions; 2) Maximum Transport of Juvenile Salmon; 3) Major System Improvements; and 4) Dam Breaching.

Appendix T evaluates compliance of the recommended plan (preferred alternative), Alternative 3—Major Systems Improvements (Adaptive Migration), with Guidelines established under Section 404(b)(1) of the Clean Water Act (Guidelines). The Guidelines provide for evaluation of the potential short- and long-term effects of the discharges upon the physical, chemical, and biological components of the aquatic environment.

The Section 404(b)(1) evaluation determined the discharges of dredged and fill material associated with Alternative 3—Major Systems Improvements (Adaptive Migration), would comply with the Guidelines, with the inclusion of appropriate and practicable measures to minimize pollution and adverse effects to the affected ecosystem.

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1. Introduction

The U.S. Army Corps of Engineers (Corps), Walla Walla District, operates four lock and dam facilities on the lower Snake River. These include the Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Dams. In response to the National Marine Fisheries Service (NMFS) 1995 Biological Opinion concerning the operation of the Federal Columbia River Power System, the Corps evaluated structural and operational alternatives to improve the downstream migration of juvenile salmonids through the four lower Snake River dams. That effort resulted in the preparation of the Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement (FR/EIS).

The purpose of the FR/EIS is to evaluate and screen structural alternative measures that may increase the survival of juvenile anadromous fish through the Lower Snake River Project and assist in the recovery of listed salmon and steelhead stocks. The FR/EIS examined four alternatives: 1) Existing Conditions; 2) Maximum Transport of Juvenile Salmon; 3) Major System Improvements; and 4) Dam Breaching.

Multiple appendices to the FR/EIS have been prepared. This appendix evaluates compliance of the recommended plan (preferred alternative), Alternative 3—Major Systems Improvements (Adaptive Migration), with Guidelines established under Section 404(b)(1) of the Clean Water Act (Guidelines).

The Federal Water Pollution Control Act (Clean Water Act) of 1972, as amended, sets national goals and policies to eliminate the discharge of water pollutants into navigable waters. Any discharge of dredged or fill material into navigable waters by the Corps requires a Clean Water Act Section 404(b)(1) evaluation to obtain a state water quality certification under Section 401 of the Federal Water Pollution Control Act. The 404(b)(1) evaluation follows a set of Guidelines developed by the Administrator of the U.S. Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army and published in 40 CFR Part 230. Referred to as the Section 404(b)(1) Guidelines, these guidelines are the substantive criteria used in evaluating discharges of dredged or fill material under Section 404 of the Clean Water Act.

The purpose of the Guidelines is to restore and maintain the chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredged or fill material. Evaluations examine practicable alternatives to the proposed discharge, which would have less adverse impact on the aquatic ecosystem. Evaluations also describe the potential short- and long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment.

This Clean Water Act, Section 404(b)(1) evaluation is not intended to function solely as a stand-alone document. Extensive information is contained in the FR/EIS and its numerous technical appendices. Because of the extensive volume of information and data, various information summaries have been included in the Section 404(b)(1) evaluation and references provided for further reading.

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2. Project Description

2.1 Purpose

The purpose of the FR/EIS is to evaluate and screen structural alternative measures that may increase the survival of juvenile anadromous fish through the four lowermost dams operated by the Corps on the Snake River and assist in the recovery of Endangered Species Act (ESA)-listed salmon and steelhead stocks. The four dams include Ice Harbor, Lower Monumental, Little Goose, and Lower Granite.

2.2 Location

The four dams that make up the Lower Snake River Project are located along the Snake River in southeast Washington. The Lower Snake River Project extends from near the confluence of the Snake and Columbia Rivers, near Pasco, Washington, to Lewiston, Idaho. Refer to the FR/EIS, Figures 1-1 and 1-2 for Project Vicinity and Regional Base Maps, respectively. Specific descriptions of the locations of the four lower Snake River dams follow:

- Ice Harbor Lock and Dam is located near Pasco, Washington in Franklin County, S.13, T.9N., R.31E., Levy, SW, Washington U.S. Geological Survey (USGS) Quad Map, and in Walla Walla County, S.24, T.9N., R.31E, Humorist, Washington USGS Quad Map.
- Lower Monumental Lock and Dam is located near Kahlotus, Washington in Franklin County, S.34, T.13N., R.34E., and Walla Walla County, S.3, T.12N., R.34E., Lower Monumental Dam, Washington USGS Quad Map.
- Little Goose Lock and Dam is located near Starbuck, Washington in Whitman and Columbia counties, S.27, T.13N., R.38E., Starbuck East, Washington USGS Quad Map.
- Lower Granite Lock and Dam is located near Pomeroy, Washington in Whitman and Garfield counties, Sections 29 and 32, T.14N., R.43E., Almota, Washington USGS Quad Map.

2.3 General Description

Following procedures of the National Environmental Policy Act (NEPA), the Corps identified a range of alternatives for meeting the purpose of evaluating and screening structural alternative measures that may increase the survival of juvenile anadromous fish through the four lowermost dams on the Snake River and assist in the recovery of ESA-listed salmon and steelhead stocks. Four alternatives were carried forward in the FR/EIS for further evaluation. Other alternatives were eliminated from consideration for various reasons. Text from the FR/EIS explaining the four alternatives carried forward, other potential actions outside the scope of the FR/EIS, and those alternatives eliminated from further consideration is reiterated below in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3, respectively. Refer to Chapters 3 and 6 of the FR/EIS for more complete descriptions of the recommended plan (preferred alternative). Further information may also be found in Section 6 of Appendix E, Existing Systems/Major System Improvements Engineering to the FR/EIS and in Annex B, Surface Bypass and Collection System Combinations to Appendix E of the FR/EIS.

The recommended plan (preferred alternative) proposes incorporation of various aspects of Alternatives 1 and 2, along with construction of new diversions to keep juvenile fish away from turbines. Aspects of Alternative 1 include continuation of project operations and utilization of existing and planned structural configurations.

Appendix T focuses on those aspects of the recommended plan (preferred alternative) that involve discharges of dredged or fill material into navigable waters of the United States. Discharges of dredged and/or fill material associated with new diversions to keep juvenile fish away from turbines would occur in association with construction of removable spillway weirs (RSWs), behavioral guidance structures (BGSs), and surface bypass collectors (SBCs). Planned structural configurations incorporated from Alternative 1 would include discharges of fill material to construct extensions to concrete pier noses, discharges of fill material to add end bay deflectors and modify existing deflectors, and discharges of dredged and fill material to construct additional sheet pile barge moorage cells and a barge access area. Extensive modifications would include discharging of fill material for bank stabilization and constructing support columns for a juvenile bypass outfall. Continued project operations from Alternative 1, which involve discharges, would include maintenance dredging. Operation of juvenile fishways to maximize fish transport from Alternative 2 would also involve discharges of dredged and fill material to construct sheet pile barge moorage cells.

2.3.1 New Diversions to Keep Juvenile Fish Away from Turbines

An RSW is a hinged metal weir attached to the face of a spillbay pier on the forebay side of the dam. The RSW passes water over its top when it is in the raised position. This allows passage of water from a higher elevation in the water column, or closer to the surface, than presently passed from a lower elevation by existing tainter gates. The RSW may be pivoted/lowered below the spillbay, where it rests on landing pads in the substrate of the forebay, or it may be raised in front of the spillbay. A float tank attached to the RSW provides buoyancy to help raise the structure from the bottom. Fish guided by the BGS would be passed directly to the tailrace via the RSW. Two RSWs are proposed to be constructed at each of the four dams, if warranted after prototype testing. A concrete landing pad would be constructed in the substrate for each RSW. The RSW rests on the landing pad while in the lowered position. Landing pad construction may require excavation to form a footing. The excavated material would likely be sidecast. The landing pads would be pre-cast concrete and would be set in place. (See FR/EIS, Appendix E, Annex B, Plate 4.1.4.)

A BGS is a barrier that guides juvenile fish away from particular powerhouse units and towards the SBC or RSW. A BGS consists of a vertical steel curtain suspended by floats. One end of the curtain is attached to the upstream face of the dam. The curtain extends from the dam into the forebay, generally perpendicular to the face of the dam. The curtain also extends vertically from the water surface to near the substrate. The floating BGS is held in position by cables attached to anchors installed in the substrate. BGSs are currently planned for Lower Granite, Lower Monumental, and Ice Harbor Dams. A BGS is not presently planned for Little Goose Dam. Construction of anchors cabled to the BGS to maintain its position may involve the discharge of both dredged and fill material. The substrate would be excavated, if necessary, and likely sidecast to form the footing for the anchor. A pre-cast concrete anchor or similar type device would be placed in the footing for attachment of the anchoring cable. An estimated 28 anchors would be installed in association with each BGS. (See FR/EIS, Appendix E, Annex B, Plates 4.1.1, 4.3.1, and 4.4.1.)

The SBCs direct juvenile fish to collection areas of the juvenile fish facility for transport by truck or barge. A single SBC could be constructed in conjunction with RSWs at each of the four dams if warranted. SBCs are metal structures attached to the upstream face of the dam, in the forebay. Construction of SBCs would likely involve excavation and drilling of rock to form footings for associated cutoff walls. Cutoff walls extend below the SBC and form a barrier that directs juvenile fish located at greater depths away from turbines and toward SBC and BGS structures. Each SBC would have a single cutoff wall. Each cutoff wall would have two footings each. The cutoff wall is described in more detail in the FR/EIS, Appendix E, Section 4.4. Excavated material and rock drill cuttings resulting from footing construction would be sidecast. (See FR/EIS, Appendix E, Annex B, Plate 4.1.3.)

2.3.2 Continuation of Project Operations and Utilization of Existing and Planned Structural Configurations (Elements of Alternative 1)

Maintenance dredging conducted under Alternative 1 would be continued under the recommended plan (preferred alternative). The extent and need for maintenance dredging is currently under evaluation by the Corps in a study entitled *Dredged Material Management Study* (DMMS). The study will produce a report entitled *Dredged Material Management Plan and Environmental Impact Statement* (DMMP/EIS), *McNary Reservoir and Lower Snake River Reservoirs*. The study includes preparation of a Clean Water Act Section 404(b)(1) Evaluation.

The completed DMMP/EIS would be the Corps' programmatic plan for maintenance of the authorized navigation channel in the four lower Snake River reservoirs between Lewiston, Idaho, and the Columbia River, and McNary Reservoir on the Columbia River for 20 years after the Record of Decision is signed. The plan would also address management of dredged material from these reservoirs and maintenance of flow conveyance capacity at the most upstream extent of the Lower Granite Reservoir for the remaining economic life of the project (to year 2074). In accordance with NEPA, consideration and analysis of a broad range of alternatives are being considered, as well as an assessment of cumulative impacts. Completion of the DMMP/EIS is not known at this printing.

Because the short- and long-term impacts of maintenance dredging upon the aquatic environment are being identified and evaluated in the Clean Water Act Section 404(b)(1) Evaluation for the DMMS, no attempt to assess impacts of maintenance dredging is undertaken in this document. The Section 404(b)(1) Evaluation completed for the DMMP/EIS would be incorporated by reference as Annex A to this Appendix T. Maintenance dredging aspects of Annex A that apply to the recommended plan (preferred alternative), including actions identified to minimize impacts, would represent the findings of Appendix T, with regard to maintenance dredging, under Section 404(b)(1) of the Clean Water Act.

Planned extensions of pier noses from Alternative 1 would be implemented as part of the recommended plan (preferred alternative). A pier nose extension is a lengthening of the existing concrete pier noses that exist between adjacent spillbays on the downstream side of the dam. Its purpose is to prevent water from adjacent spillbays from mixing together in the vicinity of the spillway deflectors. Pier nose extensions are currently planned for Lower Granite, Little Goose, and Lower Monumental Dams. There would be an estimation of seven pier nose extensions per dam. Cast-in-place concrete would be placed within a dewatered cofferdam. A temporary bulkhead would be installed that spans across the spillbays. It would be removed when the work is done.

Flow deflectors produce a thin discharge jet of water that skims the water surface of the stilling basin. The skimming jet of water prevents the spillway discharge from plunging and entraining air deep into the

stilling basin. Two end-bay deflectors would be added at Lower Monumental and Little Goose Dams. The existing deflectors at Lower Monumental, Little Goose, and Lower Granite Dams were designed to perform within a narrow range of previous tailwater elevations and spill discharges. The length, radius, and elevation of these deflectors would be modified to provide optimal performance during the more typical project operations under the current voluntary spill program.

Extensive modifications refers to proposed modifications to the existing juvenile fish facilities at Lower Granite Lock and Dam. Two aspects of the modifications would include discharges below the ordinary highwater mark of the Snake River. An eroded portion of the riverbank near the existing barge loading dock would be stabilized with grouted riprap, and concrete would be discharged into steel casings to create support columns for a juvenile bypass outfall pipe.

Construction of sheet pile barge moorage cells planned under Alternative 1 would be implemented as part of the recommended plan (preferred alternative). The barge moorage facilities would be necessary to accommodate utilization of additional juvenile fish transportation barges. The sheet pile cells would be located on the downstream side of Lower Granite Dam, adjacent to existing fish barge moorage. See Figure 2-7 of the FR/EIS for the location of the existing fish barge moorage area. Sheet pile cells would be constructed by driving sheet piling into the substrate to bedrock. Pile sections would be driven side-by-side to form a ring-shaped cell. All piling would be driven with a barge-mounted pile driver. The cells average approximately 24.8 feet in diameter. All substrate material overlaying bedrock would be excavated from the footprint of the cells and likely sidecast. The cell would then be filled with gravel. A walkway would connect the cells to the dam. H-piling would be driven to bedrock to provide intermediate support for the walkway. Two cells are currently proposed for construction at Lower Granite Dam. The barge moorage facility would be built only at Lower Granite Dam (see Figure 2-1).

A barge access area would be constructed along the face of the dam at Lower Granite Dam only. The area would allow crane access and facilitate barge maintenance. A sheet pile wall would serve as the interface between the access area and the water. Gravel fill would be placed on the sloping face of the dam and up against the sheet pile wall to form the barge access area (see Figure 2-2).

2.3.3 Maximize Transport of Juvenile Salmon (Elements of Alternative 2)

Operation of juvenile fishways to maximize fish transport for Alternative 2 would include discharges of dredged and fill material to construct sheet pile moorage facilities. The barge moorage facilities would be necessary to accommodate utilization of additional juvenile fish transportation barges. Sheet pile cells are described above under Section 2.3.2.

More complete descriptions of the above actions may be found in the FR/EIS, Appendix E, Existing Systems and Major System Improvements Engineering and Appendix J, Plan Formulation to the FR/EIS.

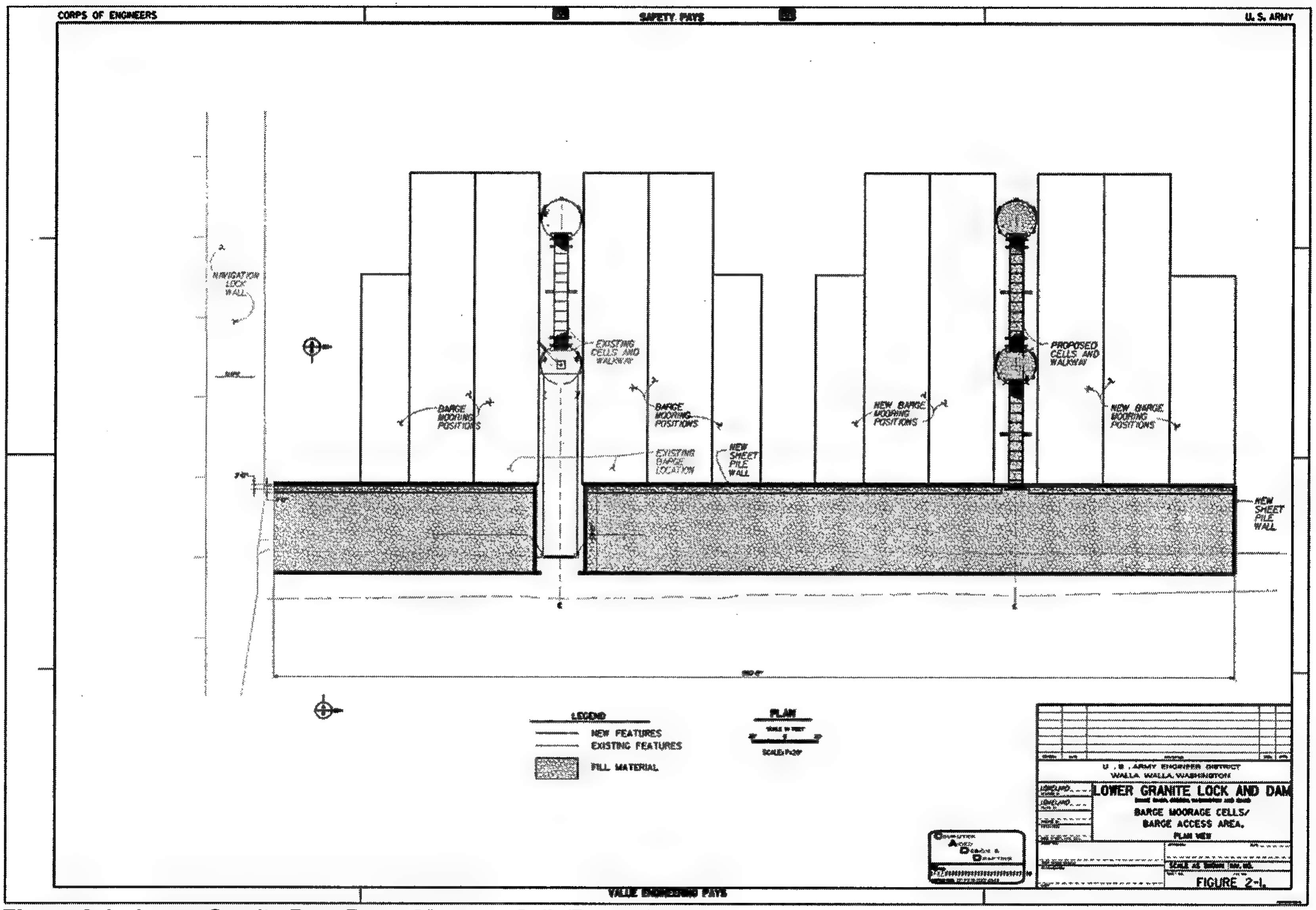

Figure 2-1. Lower Granite Dam Barge Moorage Cells/Barge Access Area

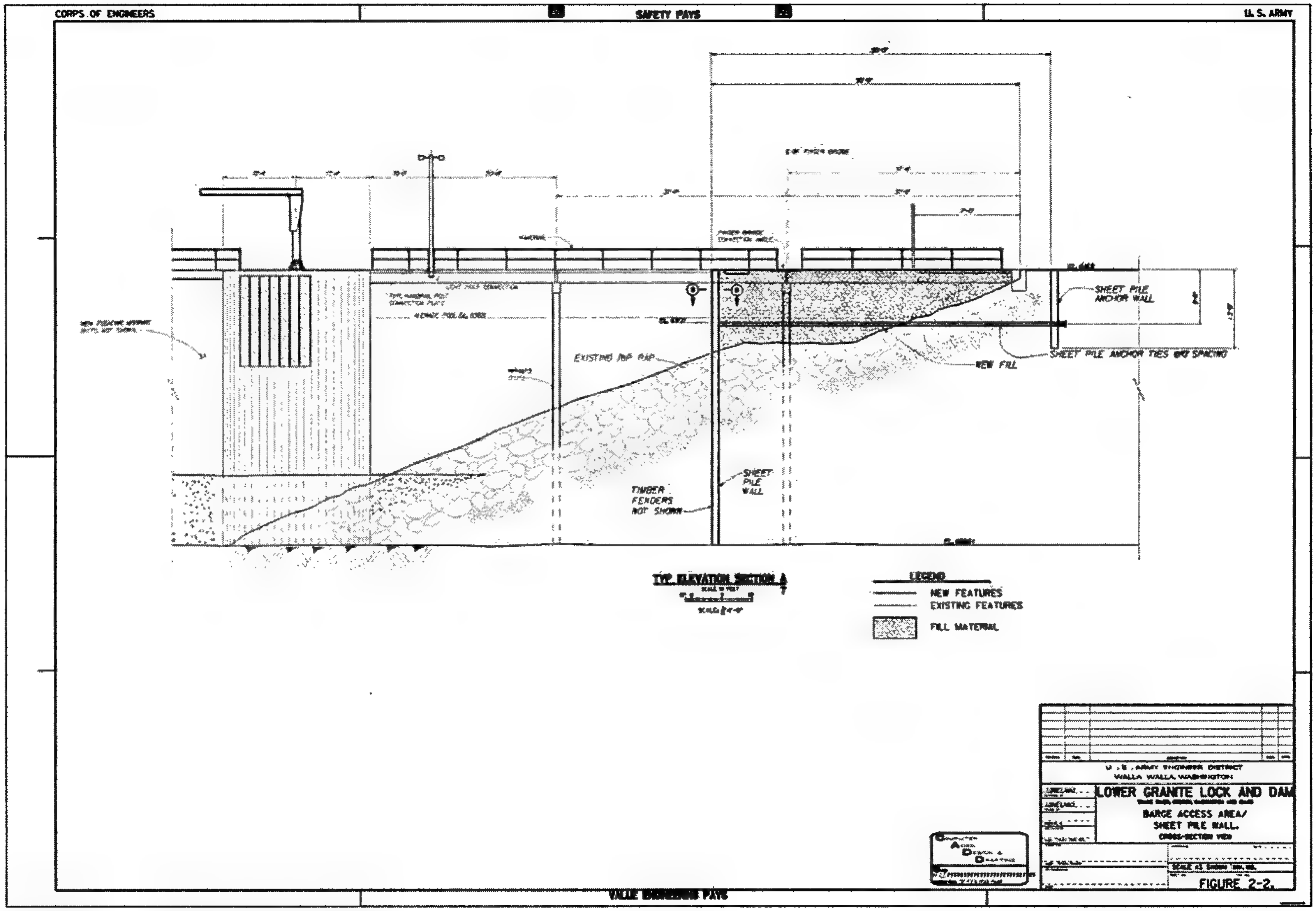

Figure 2-2. Lower Granite Dam Barge Access Area/Sheet Pile Wall

2.4 Analysis of Alternatives to the Recommended Plan (Preferred Alternative)

The 404(b)(1) Guidelines (40 CFR Part 230) are the substantive criteria used in evaluating discharges of dredged or fill material under Section 404 of the Clean Water Act. The Guidelines provide for consideration of alternatives to a proposed project. Because the NEPA process extensively examined alternatives through preparation of the FR/EIS and its numerous appendices, the 404(b)(1) evaluation focuses on practicable alternatives to the recommended plan (preferred alternative). Section 2.4.1 below presents a summary of alternatives examined through the NEPA process. Section 2.4.2 discusses the procedures used for identification of practicable alternatives to the recommended plan (preferred alternative) and presents a summary of the practicable alternatives analysis and findings.

2.4.1 Alternatives Identified through NEPA

2.4.1.1 Alternatives Carried Forward

Alternative 1—Existing Conditions

Existing conditions consists of continuing the operation of the fish passage facilities and project operations that were in place or under development at the time that this FR/EIS was initiated. They would continue to meet the authorized uses of the Lower Snake River Project. (See FR/EIS, Section 1.2, Purpose and Need; Figure 3-1, which summarizes the activities that would continue with the existing operations and activities for other alternatives; and Section 2, Affected Projects and Programs, which describes these operations in detail.) This alternative is the base case or "no action" alternative considered in the NEPA process.

Project operations would remain the same, unless modified through future actions. These would include all ancillary facilities such as fish hatcheries and Habitat Management Units (HMUs) under the Lower Snake River Fish and Wildlife Compensation Plan (Comp Plan) (see FR/EIS, Section 2.1.8, Lower Snake River Fish and Wildlife Compensation Plan); recreation facilities; power generation; and irrigation.

Adult and juvenile fish passage facilities would continue to operate. Similarly, testing of SBCs at Lower Granite Dam would continue through 2001. Information gained from this testing could be used as applicable for other projects on the Columbia River System.

Existing operations include several other measures. Detailed discussions of these measures may be found in the FR/EIS, Section 3.1. Other measures include:

- Install new turbine cams
- Install new turbine runners
- Upgrade Lower Granite juvenile fish facilities
- Upgrade fish barges
- Modify adult fish attraction
- Install trash boom at Little Goose Dam

- Modify fish separators
- Install cylindrical dewatering screens
- Install spillway flow deflectors/pier extensions
- Improve extended submerged bar screens (ESBSs).

Alternative 2—Maximum Transport of Juvenile Salmon

All of the existing or planned structural configurations from the existing conditions would be included in this alternative. Project operations would remain the same, unless modified through future actions. These would include all ancillary facilities such as fish hatcheries and HMUs under the Comp Plan, recreation facilities, power generation, navigation, and irrigation. However, this alternative assumes that the juvenile fishway systems would be operated to maximize fish transport and that voluntary spill would not be used to bypass fish through the spillways (except at Ice Harbor Dam).

To accommodate Alternative 2—Maximum Transport of Juvenile Salmon, measures would be used to maintain, upgrade, and significantly improve fish facilities (Alternative 1—Existing Conditions) that would focus on limiting in-river migration. Also, there would be no need to modify spillway flow deflectors or pier extensions with this alternative because voluntary spill would be eliminated.

Alternative 3—Major System Improvements (Adaptive Migration)

The migration strategy allows for either fish-friendly transportation or in-river migration. At Lower Granite and Lower Monumental Dams, a two-unit powerhouse surface collection channel with two RSWs would be installed if warranted after prototype testing. Surface collectors could then be used to collect fish at these two dams for downstream transportation. Lower Granite is a logical location for collecting fish for transport because it is the furthest upstream dam. It was decided to use a surface collector at Lower Monumental to allow collection of 1) fish not collected at Lower Granite, 2) fish entering the Snake River from the Tucannon River, and 3) fish released from the Lyons Ferry Hatchery.

When in transport mode, the surface collectors in front of Turbine Units 5 and 6 at Lower Granite and Lower Monumental would collect downstream migrating fish and pass them through a dewatering section in the surface collector, delivering them to the existing juvenile fish collection channel within each dam. To guide fish away from Units 1 through 4, a BGS would be constructed in the forebay.

When it is desired to keep the fish in the river, the surface collector would be shut off and the fish would be guided by the BGS past the surface collector to two RSWs. The RSWs would provide a surface attraction flow and a less stressful method of bypassing fish than what is used now for spillway passage.

As with the other system options, ESBS intake diversion systems would be used in conjunction with these two-unit SBC channels. At Lower Granite Dam, the existing ESBS would be used, whereas at Lower Monumental Dam there would be a new ESBS to replace the existing submerged traveling screens (STS). ESBSs would be located in the turbine intakes of all six units of both powerhouses to offer a bypass for fish that pass around or under the BGS.

At Little Goose Dam, a full-length powerhouse occlusion would be installed. The occlusion structure is expected to improve the performance of the ESBS and to increase the guidance of fish away from the

turbine intakes and towards the spillway. An RSW would be placed in spillbays 1 and 3 to bypass fish. The goal is to provide an effective bypass for juvenile fish. Also, each turbine unit at Little Goose Dam would have an existing ESBS in place. Fish diverted by the ESBS would be directed to the juvenile fish facilities where they would be collected for transport or returned to the river.

Two RSWs would be constructed at Ice Harbor. One RSW would be constructed on spillbay 1 and the other on spillbay 3. A BGS would extend upstream from the interface of the powerhouse and spillway. Two removable raised spillway weirs would be installed. The RSWs would provide attraction flow to the spillways and would provide a less stressful method of bypassing fish over the spillway than the current method. New ESBSs would replace the existing STS at Ice Harbor. They would be installed in the turbine intakes to offer a bypass for fish passing around or under the BGS.

Alternative 4—Dam Breaching

The dam breaching scenario differs from all other drawdown scenarios. Structural modifications would be undertaken at the dams, allowing reservoirs to be drained, and resulting in a free-flowing river that would remain unimpounded. Breaching of only one, two, or three dams was not considered in the FR/EIS because the removal of only one dam would eliminate major navigation in the lower Snake River and would curtail options for collecting and transporting juvenile fish.

With Alternative 4—Dam Breaching, the navigation locks would no longer be operational and navigation for larger vessels would be curtailed. Similarly, recreation opportunities, operation and maintenance of hatcheries and HMUs, and other activities associated with the modification from a reservoir environment to an unimpounded river in the lower Snake River would entail important changes in these activities. (See FR/EIS, Sections 5.5.2, 5.10.2, and 5.12 for details on specific changes.) No hydropower would be produced at the four dams under this alternative.

For dam breaching, the primary reason for leaving portions of the dam in place is that it meets the operational criteria at the lowest practical cost. However, modifications to structures would be done in such a manner that the structures could be restored to operating conditions with later modifications (see FR/EIS, Figure 3-3). With this alternative, reservoirs behind the four lower Snake River dams would be eliminated, which would result in a 140-mile, near-natural river. This requires the protection of structures from natural river flows and the decommissioning of equipment and structures. Secondly, construction operations would be phased so that power production, navigation, and fish migration could continue until the last possible period.

Dam breaching would involve removal of the earthen embankment section and abutment at Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Dams. Once the embankment is removed, the river would flow around the remaining structures (powerhouses, spillways, and navigation locks). Levees would be used to "shape" the river into a channel around these structures. Long-term maintenance or preservation of these powerhouses, spillways, and navigation locks would be minimal.

2.4.1.2 Other Potential Actions outside the Scope of the FR/EIS

Numerous other studies by the Corps, other Federal agencies, states, and tribes are also being conducted in the Snake River System and elsewhere in the Columbia River Basin to address salmonid species that are either at risk or listed under ESA. This FR/EIS addresses, in detail, alternatives that could be implemented at the four lower Snake River dams. This FR/EIS does not directly address all other actions being considered in the Columbia River System to conserve and restore ESA-listed salmon runs;

however, it does consider these other actions as part of the cumulative impacts analysis, discussed in the main text of the FR/EIS in resource subsections throughout Section 5, and in Section 5.16, Cumulative Effects.

Measures are also being considered at McNary, John Day, The Dalles, and Bonneville Dams to improve the effectiveness of juvenile salmon migration. These measures include additional transportation, flow deflectors, collection facilities, and spill modifications. All of these measures are in the feasibility testing phase, are under study, or have been proposed; therefore, they are not addressed in detail in this FR/EIS. They are, however, addressed in the main text of the FR/EIS in discussions of cumulative effects in resource subsections throughout Section 5, and in Section 5.16, Cumulative Effects. The actions at these lower Columbia River dams will or have been specifically addressed in detail in other NEPA documents.

2.4.1.3 Alternative Actions Eliminated from Further Consideration

A wide variety of actions and options were identified, examined, and discussed in Phases I and II of the Corps System Configuration Study (Corps, 1994). Many of these were eliminated for a number of reasons, such as: 1) significant biological and uncertainty concerns, 2) benefits of the action were less than other proposed actions, 3) potentially adverse effects to both adult and juvenile fish, 4) unacceptable impacts to turbines or other fish bypass components, and 5) potentially detrimental impacts to other resources, such as cultural.

Alternative actions that were not eliminated during the System Configuration Study received further preliminary detailed evaluation and analysis for this Feasibility Study (see Appendix J, Plan Formulation). These actions were specifically addressed and evaluated in the Interim Status Report (Corps, 1996). As part of this evaluation process, the four alternatives (Sections 3.1 to 3.4 in the main text of the FR/EIS) were selected for full evaluation while the others were eliminated for one or more of the following reasons: 1) not meeting the purpose and need of this FR/EIS; 2) the probability of success of implementation of the action was considered low or unlikely, or 3) the action would be addressed in other forums or through other NEPA analyses. The following provides general descriptions of the actions eliminated from detailed analysis. As specifically noted, the descriptions generally coincide with those alternatives evaluated in Appendix E, Existing Systems/Major System Improvements Engineering and Section 6 in the main text of the FR/EIS.

- **In-river Migration Option with Voluntary Spill under Existing Conditions (this option was evaluated by the Corps as Option A-1a—see Appendix E, Existing Systems/Major System Improvements Engineering)**

  This option assumes that the existing or currently planned juvenile fishway systems would be operated to maximize in-river fish passage and that voluntary spill would be used to bypass fish through the spillways. Because juvenile fish would remain in the river, and voluntary spill would be used to attract the fish to the spillway, additional structures to implement dissolved gas abatement would be needed (see Appendix E, Existing Systems/Major System Improvements Engineering for details).

  This option does not follow an adaptive migration strategy because no fish would be transported. Therefore, it would not meet the objectives of the NMFS 1995, 1998, or 2000 Biological Opinions. In addition, in-river migration would result in a lower direct survival of juveniles through the lower Snake River and the entire migratory corridor than a combination of in-river migration and transportation measures. For this reason, this option was eliminated from further consideration.

- **Maximized Transport at the Four Lower Snake River Facilities Without Voluntary Spill (with major SBC development at all four lower Snake River dams; this action was not specifically evaluated by Plan for Analyzing and Testing Hypotheses [PATH], but is the Corps' Option A-2b—see Appendix E, Existing Systems/Major System Improvements Engineering)**

  Under this alternative, the number of fish collected and delivered to the existing or upgraded transportation facilities located at each project would be maximized. Full-length powerhouse SBCs would be provided at Lower Granite, Little Goose, and Lower Monumental. These would be used in conjunction with ESBSs located in the turbine intakes. Fish collected by both bypass structures would be combined and delivered to the transportation facilities and either trucked or barged downstream.

  The upper two dams (Lower Granite and Little Goose) currently have ESBSs installed in the turbine intakes. These would continue to be used; however, the intakes at Lower Monumental are currently outfitted with STSs. These would be removed and replaced with ESBSs to increase the screen diversion efficiency and further reduce the number of fish passing through the turbines.

  The turbine intakes are also currently outfitted with STSs at Ice Harbor. As at Lower Monumental, these would be removed and replaced with ESBSs to increase the diversion efficiency of the screening system. No SBCs would be installed at Ice Harbor.

  If the combination of the SBC and the ESBS systems function as anticipated at Lower Granite (the major system improvements alternative), there should be very few migrating fish left in the river at the lower three dams (see Section 3.3, Alternative 3—Major System Improvements in the main text of the FR/EIS). In addition, few fish enter the Snake River between Lower Monumental and Ice Harbor; therefore, construction of SBCs at all dams would not appear to be justified. This option was eliminated from further consideration. In addition, the intent of this option is to maximize transport, which does not incorporate an adaptive migration strategy. Therefore, it does not meet the objectives of the 1995, 1998, and 2000 NMFS Biological Opinions.

- **Maximized Transport at the Four Lower Snake River Facilities with Voluntary Spill at Ice Harbor (this is similar to the Corps' Option A-2c—see Appendix E, Existing Systems/Major System Improvements Engineering)**

  This option assumes the juvenile fishway systems would be operated to maximize fish transportation and voluntary spill would only be needed at Ice Harbor to aid in bypassing fish over the spillways.

  The juvenile fish passage strategies for this option are the same as under the previous option; however, there are significant differences in designs and project operations between the two. Also, the costs for this option are considerably lower than for the previous one. The primary difference is an SBC would only be developed at Lower Granite. Only ESBSs would be used at the other three dams. This option does not incorporate an adaptive migration strategy and does not meet the objectives of the 1995, 1998, and 2000 NMFS Biological Opinions. Therefore, it was eliminated from further consideration.

- **In-river Migration Option (no transportation, no drawdown, SBCs at all dams, and flow augmentation under the 1995 Biological Opinion) Plus an Additional 1.0 MAF Flow Augmentation (this action was evaluated by the Corps as Alternative A-6a)**

  With this action, spill would be maximized to the extent possible to bypass additional fish over the spillways. There would be no transportation of juvenile fish, and in-river migration would be maximized. Augmentation flows would be increased by an additional 1.0 MAF. Therefore, the total augmentation flow would be 1,427 MAF.

  Juvenile fish would be passed directly downstream to the tailrace. To maximize diversion away from the turbines, ESBS intake diversion systems would be used in conjunction with the SBCs at all four dams to divert fish that might pass under the SBC and into the turbine intakes. Lower Granite and Little Goose already have ESBS systems. These ESBS systems would continue to be used in conjunction with the new SBCs. The STS systems at Lower Monumental and Ice Harbor would be removed and replaced with new ESBS systems.

  The Corps has an interest in flow augmentation from upstream sources and how it would affect operations and juvenile fish passage in the lower Snake River. As a result, the Corps asked BOR for assistance in developing further information on flow augmentation, particularly regarding the feasibility and potential impacts of providing the 1.0 MAF additional flow augmentation. The current findings of BOR's studies are presented in the *Snake River Flow Augmentation Impact Analysis* (BOR, 1999). The report concludes additional flow augmentation would involve high costs and multiple implementation issues. Section 7 consultation with the BOR and Idaho Power on the flow issue is continuing under a separate review process.

  Additionally, PATH did a preliminary screening analysis of this alternative, designated as Alternative A-6, which found with "most realistic" assumptions that it performed at only 80 to 100 percent of the survival and recovery criteria that PATH Alternative A-2 did. Therefore, it was unlikely this alternative would perform any better than alternatives considered fully and was not included for detailed assessment.

- **In-river Migration with No Flow Augmentation (this is the same as Corps Option 6b—see Appendix E, Existing Systems/Major System Improvements Engineering)**

  This alternative was eliminated from detailed analysis because it was not recommended in the 1995 and 1998 Biological Opinions and no flow augmentation would occur. In addition, adaptive migration would not be an objective of this option and, therefore, flexibility for implementing passage options would be limited.

  PATH performed a preliminary screening analysis alternative (designated as Alternative A-6') with very similar characteristics to this alternative but with the inclusion of SBCs at all Snake River dams to bypass fish. Even with the addition of SBCs, which should enhance dam passage survival relative to current bypass systems, the PATH preliminary analysis found that this alternative performed worse than PATH Alternative A-2 relative to the NMFS survival and recovery criteria. Therefore, considering its poor performance and NMFS' lack of recommendation in its 1995 and 1998 Biological Opinions to study this alternative, this alternative was not carried forward to full alternative analysis.

- **In-river Migration (major system improvements and flow augmentation under the 1995 Biological Opinion; this is similar to the Corps' Option A-6d—see Appendix E, Existing Systems/Major System Improvements Engineering)**

  This option assumes that juvenile fishway systems would be operated to maximize in-river fish passage. This option is similar to the previous option, except it assumes 427 KAF from upstream storage and not 1,427 KAF. It also includes different SBC components to pass fish (see Appendix E, Existing Systems/Major System Improvements Engineering). It includes, for example, the use of a BGS and RSW in lieu of a SBC at each dam, except Little Goose. A full-powerhouse, bypass-only surface collector would be used for Little Goose.

  This option also assumes that there would be no voluntary spill except at Little Goose. Adaptive migration would not be an objective of this option and, therefore, flexibility for implementing passage options would be limited.

- **Dam Removal (for PATH analysis, this action is equivalent to A-3)**

  Dam removal would include the same actions as described for dam breaching but would also include removal of all structures (e.g., spillways, powerhouses, navigation locks) at each facility. In addition, long-term maintenance of site structures or preservation of equipment would be eliminated. This alternative was not considered in detail because dam breaching would achieve the same results at a lower cost. In addition, the option of re-establishing the function of the dams in the future would be eliminated. Dam removal as an alternative would result in no increase in fish survival or recovery compared to the dam breaching without removal. Therefore, this alternative was eliminated from further consideration.

2.4.2 Alternatives Analysis Under the 404(b)(1) Guidelines

This analysis evaluates the recommended plan, identified and selected through earlier NEPA processes, for compliance with the 404(b)(1) Guidelines. The analysis does not attempt to reiterate or duplicate processes that were conducted through NEPA to identify an array of alternatives that would satisfy the purpose and need of the project, or revisit selection of the recommended plan (preferred alternative). The analysis focuses on identification of practicable alternatives to the preferred/selected alternative.

2.4.2.1 Practicable Alternatives

Practicable alternatives are defined in the Guidelines at 40 CFR Part 230.10. For clarification, the Guidelines express two clear and automatic presumptions that relate to the "water dependency" provisions of the regulations. The first presumption is that there are practicable alternatives to non-water dependent discharges proposed for special aquatic sites. "Non-water dependent discharges" are those associated with activities that do not require access or proximity to or siting within the special aquatic site to achieve their basic purpose. The second presumption is that alternatives to discharges in special aquatic sites (meaning discharges in uplands) are less damaging to the aquatic ecosystem and are environmentally preferable.

The goal of these presumptions is to verify the existence or non-existence of practicable alternative(s) to the proposed discharge by forcing a hard look at the feasibility of using environmentally preferable sites. Consequently, the Guidelines state that these presumptions are to be rebutted in order to pass the alternatives portion of the Guidelines.

The Guidelines state "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." The Guidelines emphasize that the only alternatives, which must be considered, are practicable alternatives. An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. For the purpose of this requirement, practicable alternatives include, but are not limited to:

- Activities that do not involve a discharge of dredged or fill material into the waters of the United States
- Discharges of dredged or fill material at other locations in waters of the United States.

Where the activity associated with a discharge that is proposed for a special aquatic site does not require access or proximity to or siting within the special aquatic site in question to fulfill its basic purpose (i.e., is not water dependent), practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise. In addition, where a discharge is proposed for a special aquatic site, all practicable alternatives to the proposed discharge that do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise.

2.4.2.2 Summary of Findings

As stated in 2.4.2.1, the Guidance expresses two important presumptions that are to be rebutted in order for a project to pass the alternatives portion of the guidance. Both presumptions deal with the water dependency provisions of the Guidelines. The first presumption is simply that practicable alternatives are presumed to exist for projects that do not require siting within a water of the United States (i.e., non-water dependent). The second presumption is actions that do not involve discharges into special aquatic sites are environmentally preferable. Rebuttal of the presumptions requires the following, respectively: 1) Demonstration that the recommended plan (preferred alternative) is water dependent and, therefore, cannot be accomplished without discharges into waters of the United States; and 2) Demonstration that practicable alternatives that would avoid discharges are not available.

The four alternatives, identified through the NEPA process and carried forward in the FR/EIS, would each accomplish the identified purpose, however, to varying extents. The FR/EIS, Appendix J, Plan Formulation identifies Alternative 3—Major System Improvements as the recommended plan for increasing survival of juvenile anadromous fish through the four dams and assisting in the recovery of ESA-listed salmon and steelhead stocks. Alternative 3, as well as the three other alternatives carried forward in the FR/EIS, would involve the discharge of dredged or fill material in the Snake River at each of the dams.

Because the discharges associated with the recommended plan (preferred alternative) must occur in the Snake River at the site of the four dams in order to accomplish the overall project purpose, the proposed action is determined to be water dependent. Because the action is water dependent, the recommended plan (preferred alternative) cannot be accomplished without discharges into the Snake River and cannot be conducted at alternate locations that would avoid discharges in the Snake River at the four proposed sites. Based on this, the two presumptions are effectively rebutted.

Because the two presumptions are effectively rebutted, no practicable alternatives to the recommended plan (preferred alternative) are considered available. This analysis was performed in accordance with the Guidelines for alternatives analysis identified in 40 CFR Section 230.10(a)(1-5) and satisfies the requirement of Section 403(c) of the Clean Water Act that states that alternatives be considered.

2.5 Description of Method for Dredging and Placement of Materials

2.5.1 Removable Spillway Weirs

Excavation of footings for RSW landing pads and BGS anchor footings would be conducted using a barge-mounted clamshell dredge with a 10-cubic yard (cy) bucket, or similar type equipment. Excavated material would likely be disposed in the water adjacent to the excavation site. The bucket would be lowered into the excavation site, loaded, and raised sufficient to clear the substrate. The dredge arm would then be swiveled to a position adjacent to the excavation site, and the bucket would be lowered vertically to the substrate. The bucket would then be opened and allowed to empty. The empty bucket would then be raised above the substrate, and the dredge arm would be swiveled back over the excavation site where the process would be repeated.

Landing pads would likely consist of a single section of pre-cast concrete. The landing pad would be lowered to the excavated footing using a barge-mounted crane. A diver would confirm positioning of the landing pad.

2.5.2 Behavioral Guidance System

Excavation of footings for cabled BGS anchors would be performed following the same excavation procedures described above for the RSW. Excavated material would likely be disposed in the water adjacent to the excavation site.

Each BGS anchor would likely consist of a single piece of pre-cast concrete, a ships anchor, or another similar, suitable anchor. The anchor would be placed using a barge-mounted crane. Crane cables attached to the anchors would lower the anchors to the excavation site. A diver would confirm positioning of the anchors.

2.5.3 Surface Bypass Collector

Excavation of primarily silt and clay to construct footings for SBC cutoff walls would be performed following the same excavation procedures described above for the RSW. Excavated material would likely be disposed in the water adjacent to the excavation site.

Following excavation of silt and clay, borings would be made into the bedrock or gravels and cobbles in the bottom of the footings to allow anchoring of the footings to the bedrock. Borings would be performed using an underwater pneumatic drill. The drill cuttings would likely be sidecast immediately adjacent to the footing.

Steel rods would be inserted into the boreholes and anchored using cementitious grout. The remainder of the footing would be filled with a single piece of pre-cast concrete.

2.5.4 Pier Nose Extensions

Dredging would not be required to construct pier nose extensions. Formwork would be placed on the spillway piers, and concrete would be placed in the forms. This would all be done in the area dewatered by a bulkhead. The cofferdam is a removable steel bulkhead.

2.5.4.1 Add End Bay Deflectors

A steel plate/form would be placed across the spillbay to form a tightly sealed area between the steel form and existing concrete of the spillbay. The interior of the form would be dewatered. A small amount of concrete on existing deflectors would be removed to create a bench for the new spillway deflectors. Holes would be core drilled into the existing spillbay and reinforcing steel bars would be grouted into the holes. Concrete cores would be disposed in uplands. The bars would extend above the spillbay into the location of the new deflector. Concrete would be placed between the spillbay and the steel form. Concrete would be discharged from trucks staged at the top of the dam, through a chute, to the deflector site. After the concrete has attained adequate strength, the steel form would be removed.

2.5.4.2 Modify Existing Deflectors

A steel plate/form would be placed in the same fashion as described for the addition of end bay deflectors. The interior of the form would be dewatered. The existing deflector would be removed from within the formed area by saw-cutting, jack-hammering, and drilling and splitting the concrete. Concrete sections would be removed for upland disposal using a barge mounted crane. Concrete would be discharged in a similar fashion to that described for addition of the end bay deflectors.

2.5.4.3 Bank Stabilization

Excavation of materials from below the Ordinary High Water Mark (OHWM) is not anticipated. Riprap would be placed along the bank using a backhoe sitting at the tip of the bank. Grout would be delivered to the site by a concrete mixer truck and placed using a concrete pumper truck sitting at the top of the bank.

2.5.4.4 Bypass Outfall Support Columns

Four, 30-inch diameter steel casings would be driven into the overburden and seated into the bedrock. Overburden would be removed from the interior of the casings and disposed in uplands. A 24-inch diameter hole would be drilled 10-feet into the bedrock beneath each casing. Drill cuttings would be removed and disposed in uplands. A wide flange pile would be inserted into the casing and hole. The casing and hole would be filled with concrete.

2.5.5 Sheet Pile Barge Moorage Cells and Barge Access Area

Silt and other material overlying bedrock would be excavated from the footprint of the cell and likely sidecast. Excavation would be conducted similarly to what was described in Section 2.5.1. Gravel would then be used to fill the cells. The gravel would likely be taken from a barge and placed into the cells using a 10-cy bucket lowered from a barge-mounted crane, or similar equipment.

Riprap excavated to construct the barge access area would be excavated using a barge-mounted crane. Excavated riprap would be disposed in uplands.

Gravel placed to construct the barge access area would likely be placed with a 10-cy bucket lowered from a crane stationed at the top of the dam, or similar equipment and methods.

2.6 Description of the Proposed Discharge Site

2.6.1 Removable Spillway Weirs

2.6.1.1 Location

Two landing pads would be constructed in the forebay at each of the four dams. Landing pads would be constructed approximately 88 feet upstream of existing piers. The RSW landing pads would be constructed in spillbays 3 and 5 at Lower Granite and Lower Monumental Dams and in spillbays 1 and 4 at Little Goose and Ice Harbor Dams.

2.6.1.2 Type of Site and Habitat

The Snake River at the site of the four lowermost dams is classified as a Lacustrine System, consisting of deep, open water that is permanently flooded due to impounding (Cowardin et al., 1979). The reservoir pool behind each of these four dams is approximately 30 meters (100 feet) deep at each damsite. (See FR/EIS, Appendix C, Water Quality.)

The Corps conducted sediment sampling in or near the forebay of each of the four dams in 1997. Summarized results of the in-depth particle analysis are contained in Table 2-1. The cross-section of samples at each survey site was averaged. Overall, silt and clay represent the highest concentration of sediments at all four sample sites.

2.6.1.3 Timing and Duration of Discharge

All discharges associated with construction of RSWs would occur during the standard in-water work window of December 15 through March 1, except as modified following coordination with appropriate resource agencies. The work would occur over an estimated 60-day period.

Sidecast dredged and fill material associated with construction of RSWs would be permanently discharged. The actual excavation and discharge of dredged material would occur over an estimated 24-hour period (three, 8-hour days) at each RSW landing pad site. The actual placement of pre-cast concrete into excavated footings would occur during an estimated 16-hour period (two, 8-hour days) at each RSW landing pad site. Work times within the standard in-water work window would vary based on on-site conditions.

2.6.2 Behavioral Guidance Structures

2.6.2.1 Location

A single BGS would be constructed in the forebay at each of Lower Granite, Lower Monumental, and Ice Harbor Dams. The floating BGSs would extend perpendicular to the upstream face of the dam, originating at the SBC entrance and extending 1,000-plus feet upstream, into the forebay. Paired anchors would be cabled to the structure approximately every 100 feet. (See FR/EIS, Appendix E, Annex B, Plates 4.1.1, 4.3.1, and 4.4.1.)

2.6.2.2 Type of Site and Habitat

Refer to Section 2.6.1.2 for a description of the type of site and habitat.

Table 2-1. Sediment Sampling in/near the Forebay of the Four Lower Snake River Dams

Location	Corps Sample ID#	Gravel (%)	Very Fine Gravel (%)	Very Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Very Fine Sand (%)	Silt and Clay (%)	Total (%)
Ice Harbor	IHR9.8-1 through 9.8-6	0	0	0	2	9	24	65	**100**
Lower Monumental	LMN41.8-1 through 41.8-7	0	0	0	2	3	10	84	**99**
Little Goose	LGS70.7-1 through 70.7-9	0.6	1	1	1	3	11	81	**99**
Lower Granite	LGR107.7-1 through 107.7-11	.2	.3	.3	1	1	11	84	**98**

Source: CH2M HILL, 1997

2.6.2.3 Timing and Duration of Discharge

All discharges associated with construction of BGSs would occur during the standard in-water work window of December 15 through March 1, except as modified following coordination with appropriate resource agencies. The work would occur over an estimated 60-day period. Sidecast dredged and fill material associated with construction of BGSs would be permanently discharged. The excavation and discharge of dredged material would occur during an estimated 30, 4-hour periods for all of the footings for the BGS. The placement of anchors into the excavated footings would occur during an estimated 8-hour period at each BGS site. Work times within the standard in-water work window would vary based on on-site conditions.

2.6.3 Surface Bypass Collectors

2.6.3.1 Location

A single SBC would be constructed on the upstream face of each of Lower Granite, Little Goose, and Lower Monumental Dams. A cutoff wall, extending from the bottom of the SBC downward to the substrate, would sit atop two footings. (See FR/EIS, Appendix E, Annex B, Plate 4.1.3.)

2.6.3.2 Type of Site and Habitat

Refer to Section 2.6.1.2 for a description of the type of site and habitat.

2.6.3.3 Timing and Duration of Discharge

All discharges associated with construction of SBCs would occur during the standard in-water work window of December 15 through March 1, except as modified following coordination with appropriate resource agencies. The work would occur over an estimated 45-day period. Sidecast dredged and fill material associated with construction of SBCs would be permanently discharged. The excavation and discharge of dredged material would occur during an estimated 24 hours (three, 8-hour periods) at each SBC installation site. The placement of concrete into the excavated footings would occur during an

estimated 8-hour period at each SBC installation site. Work times within the standard in-water work window would vary based on on-site conditions.

2.6.4 Pier Nose Extensions

2.6.4.1 Location

Pier nose extensions are currently proposed for construction at Lower Monumental, Little Goose, and Lower Granite Dams.

2.6.4.2 Type of Site and Habitat

The Snake River at the site of the four lowermost dams is classified as a Lacustrine System, consisting of deep, open water that is permanently flooded due to impounding (Cowardin et al., 1979).

The pier nose extensions would be constructed upon existing concrete sitting atop the substrate.

2.6.4.3 Timing and Duration of Discharge

Construction of pier nose extensions would occur during the in-water work window of December 15 through March 1, except as modified following coordination with appropriate resource agencies. The cast-in-place concrete would be permanently discharged.

2.6.5 Add End Bay Deflectors

2.6.5.1 Location

Two end bay deflectors would be installed in spillbays 1 and 8 at each of Lower Monumental and Little Goose Dams. The deflectors would be installed on the downstream portion of the spillway ogees (downstream side of the dams). See Figure 2-2 in Annex C of Appendix E for a typical spillway deflector.

2.6.5.2 Type of Site and Habitat

The Snake River at the site of the four lowermost dams is classified as a Lacustrine System, consisting of deep, open water that is permanently flooded due to impounding (Cowardin et al., 1979). The concrete would be placed over existing concrete.

2.6.5.3 Timing and Duration of Discharge

The concrete would be permanently discharged.

2.6.6 Modify Existing Deflectors

2.6.6.1 Location

All existing deflectors at Lower Monumental (six each), Little Goose (six each), and Lower Granite (eight each) Dams would be modified.

2.6.6.2 Type of Site and Habitat

The Snake River at the site of the four lowermost dams is classified as a Lacustrine System, consisting of deep, open water that is permanently flooded due to impounding (Cowardin et al., 1979). The concrete would be placed over existing concrete.

2.6.6.3 Timing and Duration of Discharge

All discharges associated with modification of existing deflectors would occur during the standard in-water work window of December 15 through March 1, except as modified following coordination with appropriate resource agencies. The concrete would be permanently discharged.

2.6.7 Bank Stabilization

2.6.7.1 Location

Bank stabilization would be constructed along approximately 150 linear feet of the left bank approximately 1,300 feet downstream of the downstream face of the Lower Granite Dam.

2.6.7.2 Type of Site and Habitat

The Snake River at the site of the four lowermost dams is classified as a Lacustrine System, consisting of deep, open water that is permanently flooded due to impounding (Cowardin et al., 1979). Riprap and grout would be placed below the OHWM upon existing riprap and grout.

2.6.7.3 Timing and Duration of Discharge

Construction would occur during the in-water work window of December 15 through March 1, except as modified following coordination with appropriate resource agencies. The riprap and grout would be permanently discharged.

2.6.8 Bypass Outfall Pipe Support Columns

2.6.8.1 Location

Supports for the bypass pipe would be constructed perpendicular to the left bank alignment approximately 1,200 feet downstream of the downstream face of Lower Granite Dam. The first pair of supports would be situated approximately 50 feet waterward from the OHWM and the second pair approximately 130 feet waterward from the OHWM.

2.6.8.2 Type of Site and Habitat

The Snake River at the site of the four lowermost dams is classified as a Lacustrine System, consisting of deep, open water that is permanently flooded due to impounding (Cowardin et al., 1979). Support columns would be placed through the substrate and into bedrock. The substrate generally consists of the same constituents identified in Table 2-1.

2.6.8.3 Timing and Duration of Discharge

Construction would occur during the in-water work window of December 15 through March 1, except as modified following coordination with appropriate resource agencies. The concrete would be permanently discharged.

2.6.9 Sheet Pile Barge Moorage Cells and Barge Access Area

2.6.9.1 Location

Sheet pile barge moorage cells and a barge access area would be constructed at Lower Granite Dam only. The new moorage cells and barge access area would be situated on the downstream side of the earthen portion of the dam (see Figures 2-1 and 2-2).

2.6.9.2 Type of Site and Habitat

The Snake River at Lower Granite Dam is classified as a Lacustrine System, consisting of deep, open water that is permanently flooded due to impounding (Cowardin et al., 1979).

No sediment sampling data is available for the site of the barge moorage cells and barge access area. Portions of the substrate are covered with riprap (see Figure 2-2). The specific site of the moorage cells and barge access area may be more generally described as low velocity backwater habitat, of which portions of the substrate are covered with riprap.

2.6.9.3 Timing and Duration of Discharge

All discharges associated with construction of moorage cells and the barge access area would occur during the standard in-water work window of December 15 through March 1, except as modified following coordination with appropriate resource agencies. The work would occur over an estimated 75-day period. Sidecast dredged material and fill material associated with construction of moorage cells would be permanently discharged. The excavation and discharge of dredged material associated with construction of the moorage cells would occur during an estimated three, 8-hour periods. Fill material associated with construction of the barge access area would also be permanently discharged. The placement of fill material to construct the barge access area would occur during an estimated eight, 8-hour periods. Work times within the standard in-water work window would vary based on on-site conditions. No discharges of dredged material would occur in association with construction of the barge access area.

2.7 General Description of Dredged or Fill Material

2.7.1 General Characteristics of Material

2.7.1.1 Dredged Material

Dredged material discharged in association with construction of RSWs, BGSs, and SBCs would generally consist of the same constituents identified in Table 2-1. In addition, the substrate is likely underlain by cobbles ranging in diameter from 1 to 6 inches and coarse gravels ranging in diameter from 1/16 inch to 1 inch.

No excavation would occur in association with the bank stabilization.

Overburden and bedrock drilled from the interior of the bypass outfall support column casings would be disposed in uplands.

No sediment sampling data are available to identify material that would be dredged from the interior of barge moorage cells. Sediment sampling is discussed in Section 3.2.1.4 of this appendix. Some riprap exists at the site; therefore, excavated material may include riprap where the footprint of the cell overlies existing riprap (see Figure 2-2). Riprap would also be excavated to construct the barge access area, but it would be disposed of in uplands.

Existing, cured concrete would be removed to facilitate modification of existing deflectors and addition of new deflectors.

2.7.1.2 Fill Material

Fill material for RSW landing pads, BGS cutoff wall footings, and SBC anchors would consist of pre-cast concrete or other similar type material. Pier nose extensions, added and modified deflectors, bank stabilization, and bypass outfall support columns would consist of cast-in-place concrete. Fill material used to construct sheet pile barge moorage cells and barge access area would consist of gravel.

2.7.2 Quantity of Material and Size of Excavation and Discharge Areas

2.7.2.1 Removable Spillway Weirs

Two RSWs would be constructed at each of the four dams, if warranted after prototype testing. The RSWs would be constructed on the upstream face of the dams. Each RSW would have a single landing pad upon which the weir would rest in the down position. Landing pads would be constructed in the substrate. All quantities are only estimates and would vary depending upon site-specific conditions.

An estimated 150 cy at Lower Granite Dam and 30 cy at Little Goose, Lower Monumental, and Ice Harbor Dams of primarily silt and clay would be excavated to form a single footing for each landing pad and would likely be sidecast as a permanent discharge of dredged material. Dimensions of the discharged dredged material would be approximately 40 feet in diameter (0.028 acre) at Lower Granite Dam and 24 feet in diameter (0.010 acre) at Little Goose, Lower Monumental, and Ice Harbor Dams, per excavated landing pad. Approximately 300 cy (0.056 acre) at Lower Granite Dam and 60 cy (0.020 acre) at Little Goose, Lower Monumental, and Ice Harbor Dams of substrate material would be permanently discharged as dredged material at each of the four dams. Total permanent discharge of dredged material for all four dams (eight landing pads) would be approximately 480 cy (0.116 acre).

An estimated 142 cy of pre-cast concrete or similar type material would be permanently discharged as fill material for each landing pad. The permanently discharged fill material would encompass approximately 0.018 acre per pad. Approximately 284 cy (0.036 acre) of pre-cast concrete would be permanently discharged as fill material at each of the four dams. Total permanent discharge of fill material for all four dams (eight landing pads) would be approximately 1,136 cy (0.144 acre) (see Table 2-2).

2.7.2.2 Behavioral Guidance Structures

A single BGS would be constructed at each of Lower Granite, Lower Monumental, and Ice Harbor Dams. A BGS would not be installed at Little Goose Dam. Anchors cabled to the BGS would be placed in the substrate. An average of 28 anchors would be installed in association with each of the three BGSs for an estimated total of 84 anchors. All quantities are only estimates and would vary depending upon site-specific conditions.

An estimated 67 cy at Lower Granite Dam and 15 cy at Lower Monumental and Ice Harbor Dams of substrate material would be excavated to form a single footing for each anchor and would likely be sidecast as a permanent discharge of dredged material. Dimensions of the discharged dredged material would be approximately 30 feet in diameter (0.016 acre) at Lower Granite Dam and 18 feet in diameter (0.0060 acre) at Lower Monumental and Ice Harbor Dams, per anchor. Approximately 1,876 cy (0.45 acre) at Lower Granite Dam and 420 cy (0.168 acre) at Lower Monumental and Ice Harbor Dams of

Table 2-2. Excavation and Discharge Quantity and Area Totals for Removable Spillway Weir

Location	Work Item Description	Excavation	Dredged Material Discharge (Permanent)	Fill Material Discharge (Permanent)
Lower Granite	Landing Pad (2 total)	300 cy total (150 cy/pad) 0.036 acre total (0.018 acre/pad)	300 cy total (150 cy/pad) 0.056 acre 0.028 acre/pad	284 cy total (142 cy/pad) 0.036 acre total (0.018 acre/pad)
Little Goose	Landing Pad (2 total)	60 cy total 30 cy/pad 0.036 acre total (0.018 acre/pad)	60 cy total (30 cy/pad) 0.020 acre 0.010 acre/pad	284 cy total (142 cy/pad) 0.036 acre total (0.018 acre/pad)
Lower Monumental	Landing Pad (2 total)	60 cy total (30 cy/pad) 0.036 acre total (0.018 acre/pad)	60 cy total (30 cy/pad) 0.020 acre 0.010 acre/pad	284 cy total (142 cy/pad) 0.036 acre total (0.018 acre/pad)
Ice Harbor	Landing Pad (2 total)	60 cy total (30 cy/pad) 0.036 acre total (0.018 acre/pad)	60 cy total (30 cy/pad) 0.020 acre 0.010 acre/pad	284 cy total (142 cy/pad) 0.036 acre total (0.018 acre/pad)
Totals		**480 cy total** **0.14 acre total**	**480 cy total** **0.116 acre total**	**1,136 cy total** **0.144 acre total**

Source: Corps, 2001

substrate material would be permanently discharged as dredged material. Total discharge of dredged material for all three dams (84 anchors) would be approximately 2,716 cy (0.786 acre).

Approximately 128 cy of pre-cast concrete would be permanently discharged as fill material for each anchor. Dimensions of each anchor would be approximately 20 feet by 20 feet (0.0092 acre). Approximately 3,584 cy (0.257 acre) of pre-cast concrete would be permanently discharged as fill material at each of the three dams. Total discharge of fill material for all three dams (84 anchors) would be approximately 11,000 cy (0.77 acre) (see Table 2-3).

2.7.2.3 Surface Bypass Collectors

An SBC would be constructed at Lower Granite, Little Goose, and Ice Harbor Dams. Each SBC would have a single cutoff wall. Each cutoff wall would have two footings resulting in eight total footings. Cutoff walls would be embedded/anchored in footings in the substrate. All quantities are estimates only and would vary depending upon site-specific conditions.

An estimated 88 cy at Lower Granite Dam and 20 cy at Little Goose and Lower Monumental Dams of primarily silt and clay with an incidental quantity of rock drill cuttings would be excavated to form a

Table 2-3. Excavation and Discharge Quantity and Area Totals for Behavioral Guidance Structure

Location	Work Item Description	Excavation	Dredged Material Discharge (Permanent)	Fill Material Discharge (Permanent)
Lower Granite	Anchors (28 total)	1,876 cy total (67 cy/anchor) 0.26 acre total (0.0092 acre/anchor)	1,876 cy total (67 cy/anchor) 0.45 acre total 0.016 acre/pad	3,584 cy total (128 cy/anchor) 0.2576 acre total (0.0092 acre/anchor)
Lower Monumental	Anchors (28 total)	420 cy total (15 cy/anchor) 0.26 acre total (0.0092 acre/anchor)	420 cy total (15 cy/anchor) 0.168 acre total 0.0060 acre/pad	3,584 cy total (128 cy/anchor) 0.2576 acre total (0.0092 acre/anchor)
Ice Harbor	Anchors (28 total)	420 cy total (15 cy/anchor) 0.26 acre total (0.0092 acre/anchor)	420 cy total (15 cy/anchor) 0.168 acre total 0.0060 acre/pad	3,584 cy total (128 cy/anchor) 0.2576 acre total (0.0092 acre/anchor)
Totals		**2,716 cy total** **0.78 acre total**	**2,716 cy total** **0.786 acre total**	**11,000 cy total** **0.77 acre total**

single footing and likely sidecast as a permanent discharge of dredged material. Dimensions of the discharged dredged material would be approximately 33 feet in diameter (0.020 acre) at Lower Granite Dam and 20 feet in diameter (0.007 acre) at Little Goose and Lower Monumental Dams, per footing. Approximately 176 cy (0.040 acre) at Lower Granite Dam and 40 cy (0.014 acre) at Little Goose and Lower Monumental Dams of substrate material and rock drill cuttings would be permanently discharged as dredged material at each of the three dams. Total permanent discharge of dredged material for all three dams (six footings) would be approximately 256 cy (0.068 acre).

Approximately 15 cy of pre-cast concrete would be permanently discharged as fill material for each footing. Dimensions of the permanently discharged fill material would be approximately 10 feet by 10 feet (0.0023 acre), per footing. Approximately 30 cy (0.0046 acre) of pre-cast concrete would be permanently discharged as fill material at each of the three dams. Total discharge of fill material for all three dams (six footings) would be approximately 90 cy (0.0138 acre) (see Table 2-4).

2.7.2.4 Pier Nose Extensions

An estimated seven pier nose extensions would be constructed at each of the three dams identified in Table 2-5. Each extension would consist of approximately 60 cy of cast-in-place concrete and would encompass an estimated 0.002 acre (see Table 2-5). All quantities are estimates only and would vary depending upon site-specific conditions.

2.7.2.5 Add End Bay Deflectors

A total of two end bay deflectors would be added at each of Little Goose and Lower Monumental Dams. Approximately 10 cy of existing concrete would be removed to facilitate construction of each deflector (40 cy total). Approximately 240 cy of concrete would be discharged as fill material for each deflector (960 cy total). See Table 2-6.

Table 2-4. Excavation and Discharge Quantity and Area Totals for Surface Bypass Collectors

Location	Work Item Description	Excavation	Dredged Material Discharge (Permanent)	Fill Material Discharge (Permanent)
Lower Granite	Cutoff Wall Footings (2 total)	176 cy total (88 cy/footing) 0.036 acre total (0.018 acre/footing)	176 cy total (88 cy/footing) 0.040 acre total 0.020 acre/footing	30 cy total (15 cy/footing) 0.0046 acre total (0.0023 acre/pad)
Little Goose	Cutoff Wall Footings (2 total)	40 cy total (20 cy/footing) 0.0088 acre total (0.0044 acre/footing)	40 cy total (20 cy/footing) 0.014 acre total 0.007 acre/footing	30 cy total (15 cy/footing) 0.0046 acre total (0.0023 acre/pad)
Lower Monumental	Cutoff Wall Footings (2 total)	40 cy total (20 cy/footing) 0.0088 acre total (0.0044 acre/footing)	40 cy total (20 cy/footing) 0.014 acre total 0.007 acre/footing	30 cy total (15 cy/footing) 0.0046 acre total (0.0023 acre/pad)
Totals		**128 cy total 0.054 acre total**	**256 cy total 0.068 acre total**	**90 cy total 0.0138 acre total**

Table 2-5. Excavation and Discharge Quantity and Area Totals for Pier Nose Extensions

Location	Work Item Description	Excavation	Dredged Material Discharge	Fill Material Discharge (Permanent)
Lower Granite	Pier Nose Extension (7 total)	0.0 cy total 0.0 acre total	0.0 cy total 0.0 acre total	420 cy total (60 cy/extension) 0.014 acre total (0.002 acre/extension)
Little Goose	Pier Nose Extension (7 total)	0.0 cy total 0.0 acre total	0.0 cy total 0.0 acre total	420 cy total (60 cy/extension) 0.014 acre total (0.002 acre/extension)
Lower Monumental	Pier Nose Extension (7 total)	0.0 cy total 0.0 acre total	0.0 cy total 0.0 acre total	420 cy total (60 cy/extension) 0.014 acre total (0.002 acre/extension)
Totals		**0.0 cy total 0.0 acre total**	**0.0 cy total 0.0 acre total**	**1,260 cy total 0.042 acre total**

Table 2-6. Excavation and Discharge Quantity and Area Totals for Add End Bay Deflectors

Location	Work Item Description	Excavation	Dredged Material Discharge	Fill Material Discharge (Permanent)
Little Goose	Add Deflectors	20 cy total	0 cy total	480 cy total
	(2 total)	10 cy/deflector	(0 cy/deflector)	(240 cy/deflector)
		0.012 acre total	0 acre	0.052 acre total
		(0.006 acre/ deflector)		(0.026 acre/deflector)
Lower Monumental	Add Deflectors	20 cy total	0 cy total	480 cy total
	(2 total)	(10 cy/deflector)	(0 cy/deflector)	(240 cy/deflector)
		0.012 acre total	0 acre	0.052 acre total
		(0.006 acre/ deflector)		(0.026 acre/deflector)
Totals		**40 cy total**	**0 cy total**	**960 cy total**
		0.024 acre total	**0 acre total**	**0.104 acre total**

2.7.2.6 Modify Existing Deflectors

A total of eight deflectors at Lower Granite and six deflectors at each of Little Goose and Lower Monumental would be modified. Existing concrete deflectors would be removed and disposed in uplands. Existing deflectors would consist of approximately 250 cy per deflector (5,000 cy total). An estimated 240 cy of concrete would be discharged per deflector as fill material (5,955 cy total). See Table 2-7.

2.7.2.7 Bank Stabilization

Approximately 12.8 cy of fill material (riprap and cement grout) would be discharged below the OHWM. See Table 2-8.

2.7.2.8 Bypass Outfall Support Columns

An estimated 17.7 cy of sand, gravel, and fractured basalt would be excavated from the interior of the steel casings. This material would be disposed in uplands. A total of approximately 40.7 cy of concrete would be discharged as fill material into the interior of the support columns. See Table 2-9.

2.7.2.9 Sheet Pile Barge Moorage Cells and Barge Access Area

Moorage cells would be constructed at Lower Granite Dam only. An estimated two cells total would be constructed. Cells would be formed by driving sheet piling into the river bottom. Each cell would be approximately 24.8 feet in diameter. There are 2,950 square feet of sheet pile below the water line for each cell; a total of 5,900 square feet. After driving the piling, substrate material in the interior of the cell (about 5 feet thick) would be excavated using a barge-mounted crane and bucket. The volume of excavated soil would be about 88 cy per cell. The material would likely be sidecast and cover an area of about 0.020 acre per cell. The total amount of excavated material would be about 176 cy and the total disposal area would be about 0.040 acre. Approximately 670 cy of gravel would be placed in each cell below the water line for a total of 1,340 cy of gravel placed in both cells below the water line. All quantities are only estimates and would vary depending upon site-specific conditions.

Table 2-7. Excavation and Discharge Quantity and Area Totals for Modifying Deflectors

Location	Work Item Description	Excavation	Dredged Material Discharge (Permanent)	Fill Material Discharge (Permanent)
Lower Granite	Modify Deflectors (8)	2,000 cy total for deflectors (250 cy/ deflector) 0.28 acre total for deflectors (0.026 acre/ deflector)	0 cy total (0 cy/deflector) 0 acre	1,920 cy total for deflectors (240 cy/deflector) 0.208 acre total for deflectors (0.026 acre/deflector)
Little Goose	Modify Deflectors (6)	1,500 cy total for deflectors 250 cy/defector 0.156 acre total for deflectors (0.026 acre/ deflector)	0 cy total (0 cy/deflector) 0 acre	1,440 cy total for deflectors (240 cy/deflector) 0.156 acre total for deflectors (0.026 acre/deflector)
Lower Monumental	Modify Deflectors (6)	1,500 cy total for deflectors (250 cy/ deflector) 0.156 acre total for deflectors (0.026 acre/ deflector)	0 cy total (0 cy/deflector) 0 acre	1,440 cy total for deflectors (240 cy/deflector) 0.156 acre total for deflectors (0.026 acre/deflector)
Totals		**5,000 cy total** **0.52 acre total**	**0 cy total** **0 acre total**	**5,955 cy total** **0.63 acre total**

Table 2-8. Excavation and Discharge Quantity and Area Totals for Bank Stabilization

Location	Work Item Description	Excavation	Dredged Material Discharge (Permanent)	Fill Material Discharge (Permanent)
Lower Granite	Bank Stabilization	0 cy 0 acre	0 cy 0 acre	12.8 cy total 0.015 acre
Totals		**0 cy total** **0 acre total**	**0 cy total** **0 acre total**	**12.8 cy total** **0.015 acre total**

Table 2-9. Excavation and Discharge Quantity and Area Totals for Outfall Support Columns

Location	Work Item Description	Excavation	Dredged Material Discharge (Permanent)	Fill Material Discharge (Permanent)
Lower Granite	Bypass Outfall Support Columns (4)	17.7 cy total for 4 columns (4.4 cy/column) 0.0004 acre total (0.0001 acre/column)	0 cy (0 cy/column) 0 acre	40.7 cy total for 4 columns (10.2 cy/column) 0.0004 acre total (0.0001 acre/column)
Totals		**17.7 cy total** **0.0004 acre total**	**0 cy total** **0 acre total**	**10.7 cy total** **0.0004 acre total**

An access to the moorage cells and moored barges would be constructed along the face of the dam to allow crane access and facilitate barge maintenance. A sheet pile wall would serve as the interface between the access area and the water. The sheet pile wall along the face of the dam would be 570 feet long and have 21,660 square feet of wall below water. There would be about 1,900 cy of riprap excavation covering approximately 0.40 acre from the face of the dam below the waterline and behind the new sheet pile wall. All excavated riprap would be disposed in uplands. Approximately 2,100 cy of gravel fill would then be placed behind the wall below the waterline (see Table 2-10). All quantities are only estimates and would vary depending upon site-specific conditions.

2.7.3 Source of Material

2.7.3.1 Removable Spillway Weirs

Dredged material discharged in association with construction of the RSW landing pads would originate from excavation of the landing pad footings in the forebay. The source for pre-cast concrete landing pads would likely be a local commercial concrete production plant.

2.7.3.2 Behavioral Guidance System

Dredged material discharged in association with construction of the BGS anchor footings would originate on site from excavation of the footings in the forebay. The source for the pre-cast concrete footing would likely be a local commercial concrete production plant.

2.7.3.3 Surface Bypass Collector

Dredged material discharged in association with construction of the SBC cutoff wall footings would originate on site from excavation of the footings in the forebay. The source for the pre-cast concrete anchors would likely be a local commercial concrete production plant.

2.7.3.4 Pier Nose Extensions

Cast-in-place concrete fill material discharged to construct pier nose extensions would be obtained from a local commercial concrete production plant.

Table 2-10. Excavation and Discharge Quantity and Area Totals for Sheet Pile Barge Moorage Cells and Barge Access Area

Location	Work Item Description	Excavation	Dredged Material Discharge (Permanent)	Fill Material Discharge (Permanent)
Lower Granite	Sheet Pile Moorage Cell (2 Total)	176 cy total (88 cy/cell) 0.022 acre total (0.011 acre/cell)	176 cy total (88 cy/cell) 0.040 acre total	1,340 cy total (670 cy/cell) 0.022 acre total (0.011 acre/cell)
	Barge Access Area	1,900 cy total 0.40 acre total	0 cy total 0.0 acre total	2,100 cy total 0.45 acre total
Totals		**2,076 cy total (0.42 acre total)**	**176 cy 0.04 acre**	**3,440 cy total 0.47 acre**

2.7.3.5 Add End Bay Deflectors

Cast-in-place concrete fill material discharged to add end bay deflectors would be obtained from a local commercial concrete production plant.

2.7.3.6 Modify Existing Deflectors

Cast-in-place concrete fill material discharged to modify existing deflectors would be obtained from a local commercial concrete production plant.

2.7.3.7 Bank Stabilization

Riprap and concrete would be obtained from local commercial sources.

2.7.3.8 Bypass Outfall Support Columns

Concrete would be obtained from a local commercial source.

2.7.3.9 Sheet Pile Barge Moorage Cells and Barge Access Area

Dredged material discharged in association with construction of the moorage cells at Lower Granite Dam would originate on site, downstream of the earthen embankment portion of the dam. The source for the rock and gravel fill material discharged into the moorage cells and behind the sheet pile wall for the barge access area would be a local commercial source.

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3. Factual Determinations

3.1 Physical Substrate Determinations

3.1.1 Dredged Material

Dredged material would likely be discharged in association with construction of the RSW landing pads, BGS anchor sites, SBC cutoff wall support footings, and barge moorage cells.

Sidecasting of silt and clay, sand, and gravel excavated to form footings for the RSW landing pads, BGS anchor sites, SBC cutoff wall support footings, and construction of moorage cells, would permanently elevate the existing substrate at the discharge site. Actual changes in the substrate elevation and slope are predicted to be negligible due to the limited quantity of material and anticipated settling of the material at the discharge site. Immobile bottom-dwelling organisms would likely be smothered by the discharge. Some mobile organisms would also likely be smothered; however, most would temporarily migrate from the discharge site. Colonization of the newly elevated substrate to concentrations similar to pre-discharge conditions should occur in the short term due to consistency in particle size. The dredged material would originate on site; therefore, there would be no change in the chemical constituents of the materials.

Sidecast dredged material would be confined to areas immediately adjacent to the excavation site to minimize transport distance of the material and minimize the footprint of the discharge. Negligible movement of discharged dredged material is predicted due to the depth of the water at the discharge site and tendency for clay and silt to settle out in this area of slow-moving water.

Sections 3.4.1, 3.4.2, and 3.4.3 discuss effects on turbidity, contaminants, and biota, respectively.

3.1.2 Fill Material

Placement of pre-cast concrete for RSW landing pads, BGS anchors, and SBC cutoff wall support footings would permanently replace the clay and silt, sand, and gravel substrate excavated to form the footings. Negligible changes in the substrate elevation and slope would result from existence of the RSW landing pads and BGS anchors due to their profile. No movement of the concrete landing pads or anchors is anticipated. Little or no impact would occur upon benthics directly from the placement of the landing pads or anchors, due to prior disturbance of the site through excavation. The exposed concrete landing pads and anchors would not be conducive to benthic re-colonization in the short term. In the long term, however, following natural deposition of clay and silt over the concrete, recolonization should occur. Some future short-term disturbance of benthics would occur when the RSW is lowered to rest on the landing pad. The SBC cutoff wall support footings would cause minimal change in substrate elevation and slope. The concrete footings, with the cutoff wall sitting atop it, would permanently change the substrate elevation and slope and would permanently eliminate the substrate within the footprint of the concrete footings. Minimal disturbance of benthics would result from placement of the footings due to prior disturbance of the site through excavation. Re-colonization of the concrete footings would be marginal due to the concrete cutoff wall sitting atop the footings.

Cast-in-place concrete used to construct pier nose extensions and end bay deflectors and to modify existing deflectors would be placed upon existing concrete that covers the substrate. Riprap and cement grout discharged to construct the bank stabilization would be placed upon existing riprap. Concrete discharged into the interior of the bypass outfall support columns would permanently eliminate the

substrate within the interior of the columns. Gravel discharged in the interior of the barge moorage cells and barge access area would replace the substrate at the discharge site, including substrate areas covered with riprap, for the cells with footprints on existing riprap. The gravel fill in the barge access area would be placed atop existing riprap. The gravel fill would permanently eliminate the substrate within the interior of the moorage cells and beneath the barge access fill. Gravel discharged in the interior of the barge moorage cells would have negligible short-term effects on benthics due to prior disturbance of the site through excavation. Long-term effects would occur upon benthics through the permanent elimination of the substrate within the footprint of the cells. Long-term permanent effects upon benthics would result from the barge access fill.

3.1.3 Actions Taken to Minimize Impacts

The following actions would be taken to minimize impacts:

- Sidecast dredged material would be confined to areas immediately adjacent to the excavation site to minimize transport distance of the material and minimize the footprint of the discharge.
- Excavation would be held to the minimum necessary to lessen impacts to the substrate.
- Pre-cast concrete would be adequately cured before placement in the water.
- Materials excavated from the interior of the bypass outfall support columns would be disposed in uplands.
- Cast-in-place concrete would be placed within an area dewatered by a cofferdam/bulkhead.

3.2 Chemical Description of Materials

The materials to be dredged are mostly sedimentary in nature. As the runoff from adjacent land and from upper river contributions travels with the freshets, fine particulate matter is carried with the current until the velocities slow enough to allow for settling in the calmer portions of the reservoir. This discussion focuses on the materials referred to as "fines." These materials tend to be rich in organic materials and, thus, have the best potential to harbor deleterious or beneficial constituents. In terms of concentration, nutrients such as ammonia, organic nitrogen, phosphorus, and sulfate make up the bulk of sediment constituents. A portion of these sediments harbor pesticide and herbicide compounds and their degradation products.

A variety of elements and organic compounds have entered the environment as a result of human activities. Such substances find their way into the aquatic environment through runoff, direct discharges, and settled airborne particulate matter. Some of these chemicals are known to harm aquatic life by direct toxicity, reducing viability, or limiting reproductive success (Bonn, 1999). The sediment history of the lower Snake River is as much a part of the agricultural history as it is a history of chemical usage. In the 20th century, the primary use of land adjacent to the lower Snake River was agricultural (Drawdown Regional Economic Workgroup [DREW], 1999). Therefore, the sediment chemistry in the Snake River is likely to be a legacy of the agricultural chemicals used in the 20th century.

3.2.1 Dredged Material

3.2.1.1 Removable Spillway Weirs

Ice Harbor Forebay

Sediment quality determinations are taken from the 1997 sediment investigation of the lower Snake River (Anatek Labs, 1997). Constituent values of organic compounds were as follows: 3.83 micrograms per kilogram (μg/kg) of 4,4-dichloro-diphenyl-dichloro-ethylene (DDE); 1.1 μg/kg glyphosate; and 61 milligrams per kilogram (mg/kg) total petroleum hydrocarbons (TPH). Tests were conducted for other organic constituents, but none were detected (Anatek Labs, 1997). The concentration values of metals in the forebay were as follows: 0.68 mg/kg beryllium (Be); 53.5 mg/kg vanadium (V); 20.8 mg/kg chromium (Cr); 1,041 mg/kg manganese (Mn); 11.6 mg/kg cobalt (Co); 14.9 mg/kg nickel (Ni); 21.9 mg/kg copper (Cu); 57.2 mg/kg zinc (Zn); 8.09 mg/kg arsenic (As); 1.89 mg/kg selenium (Se); 0.44 mg/kg molybdenum (Mo); 178 mg/kg barium (Ba); 0.23 mg/kg thallium (Tl); and 13.1 mg/kg lead (Pb). The mean inorganic nutrient concentration of the Ice Harbor forebay was 81.4 mg/kg ammonia; 1,317.1 mg/kg total Kjeldahl nitrogen; 0.7 mg/kg nitrite/nitrate; 2.5 percent organic carbon; 37.7 mg/kg phosphorus; and 7.7 mg/kg sulfate. The mean parts hydronium (pH) of the soil was 6.9 units.

Lower Monumental Forebay

Sediment quality determinations are taken from the 1997 sediment investigation of the lower Snake River (Anatek Labs, 1997). Constituent values of organic compounds were as follows: 6.99 μg/kg 4,4-DDE and 58.91 mg/kg TPH. The concentration values of metals in the forebay were as follows: 0.74 mg/kg Be; 47.3 mg/kg V; 25.4 mg/kg Cr; 829 mg/kg Mn; 11.8 mg/kg Co; 15.5 mg/kg Ni; 23.3 mg/kg Cu; 54.8 mg/kg Zn; 8.09 mg/kg As; 2.04 mg/kg Se; 0.51 mg/kg Mo; 202 mg/kg Ba; 0.15 mg/kg Mercury (Hg); 0.23 mg/kg Tl; and 13.1 mg/kg Pb. The mean inorganic nutrient concentration of the Lower Monumental forebay was 81.4 mg/kg ammonia; 1,146.1 mg/kg total Kjeldahl nitrogen; 0.6 mg/kg nitrite/nitrate; 2.2 percent organic carbon; 38.2 mg/kg phosphorus; and 8.4 mg/kg sulfate. The mean soil pH was 6.9 units.

Little Goose Forebay

Sediment quality determinations are taken from the 1997 sediment investigation of the lower Snake River (Anatek Labs, 1997). Constituent values of organic compounds were as follows: 8.96 μg/kg 4,4-DDE; 3.0 μg/kg glyphosate; and 45.18 mg/kg TPH. The concentration values of metals in the forebay were as follows: 0.77 mg/kg Be; 53.5 mg/kg V; 25.6 mg/kg Cr; 848 mg/kg Mn; 13.2 mg/kg Co; 17.4 mg/kg Ni; 29.77 mg/kg Cu; 65.0 mg/kg Zn; 6.70 mg/kg As; 1.68 mg/kg Se; 0.32 mg/kg Mo; 212 mg/kg Ba; 0.12 mg/kg Hg; 0.24 mg/kg Tl; and 14.37 mg/kg Pb. The mean inorganic nutrient concentration of the Little Goose forebay was 64.3 mg/kg ammonia; 1,344.1 mg/kg total Kjeldahl nitrogen; 0.7 mg/kg nitrite/nitrate; 3.3 percent organic carbon; 35 mg/kg of phosphorus; and 10.5 mg/kg sulfate. The mean soil pH was 7.1 units.

Lower Granite Forebay

Sediment quality determinations are taken from the 1997 sediment investigation of the lower Snake River (Anatek Labs, 1997). Constituent values of organic compounds were as follows: 10.17 μg/kg 4,4-DDE;

6.76 μg/kg 4,4- dichloro-diphenyl-dichloro-ethane (DDD); 3.0 μg/kg glyphosate; and 82.25 mg/kg TPH. The concentration values of metals in the forebay were as follows: 0.77 mg/kg Be; 84.0 mg/kg V; 24.4 mg/kg Cr; 517.5 mg/kg Mn; 13.28 mg/kg Co; 16.98 mg/kg Ni; 32.81 mg/kg Cu; 68.3 mg/kg Zn; 6.78 mg/kg As; 1.68 mg/kg Se; 0.33 mg/kg Mo; 198 mg/kg Ba; 0.15 mg/kg Hg; 0.23 mg/kg Tl; and 15.75 mg/kg Pb. The mean inorganic nutrient concentration of the Lower Granite forebay was 75.7 mg/kg ammonia; 1,746.5 mg/kg total Kjeldahl nitrogen; 1.4 mg/kg nitrite/nitrate; 5.2 percent organic carbon; 34.1 mg/kg of phosphorus; and 17.9 mg/kg sulfate. The mean soil pH was 6.8 units.

3.2.1.2 Behavioral Guidance Structures

The chemical quality of the sediment is the same as described in Section 3.2.1.1.

3.2.1.3 Surface Bypass Collectors

The chemical quality of the sediment is the same as described in Section 3.2.1.1.

3.2.1.4 Sheet Pile Barge Moorage Cells

Dredged material would primarily consist of basalt or igneous rock with intermixed silt and sand. Some riprap may be excavated and discharged as dredged material. No chemical data are available for the silt material. Prior to construction, sediment samples would be obtained and analyzed for chemical constituents, including particle size.

3.2.1.5 Barge Access Area

No discharges of dredged material would occur in association with construction of the barge access area.

3.2.1.6 Pier Nose Extensions

Construction of pier nose extensions would not require excavation or discharges of dredged material.

3.2.1.7 Add End Bay Deflectors

No discharge of dredged material is anticipated.

3.2.1.8 Modify Existing Deflectors

No discharge of dredged material is anticipated.

3.2.1.9 Bank Stabilization

No discharge of dredged material is anticipated.

3.2.1.10 Bypass Outfall Support Column

No discharge of dredged material is anticipated.

3.2.2 Fill Material

3.2.2.1 Removable Spillway Weirs

The RSWs are bolted to the upstream concrete face of the dam. Drill cuttings, similar in texture to coarse sand, would not have a measurable effect to the water column and would not exceed one half of a cubic foot in total material. Landing pads would be constructed of washed gravel and sand mixed with Portland

cement in accordance with the specification for American Society for Testing and Materials (ASTM) C150, Type I or II.

3.2.2.2 Behavioral Guidance Structure

The series of concrete anchors used to secure the BGS would likely consist of washed gravel and sand mixed with Portland cement in accordance with specification ASTM C150, Type I or II.

3.2.2.3 Surface Bypass Collectors

SBC structures would be bolted directly to the upstream concrete face of the dam. Concrete drill cuttings, similar in texture to coarse sand, would not exceed one half of a cubic foot in total material. The concrete footings would consist of washed gravel and sand mixed with Portland cement in accordance with specification for ASTM C150, Type I or II.

3.2.2.4 Sheet Pile Barge Moorage Cells

The cells would be filled with gravel that would be washed of any silts and soils prior to placement.

3.2.2.5 Barge Access Area

The barge access area would be filled with gravel that would be washed of any silts and soils prior to placement.

3.2.2.6 Pier Nose Extensions

The pier nose extensions would be cast-in-place concrete consisting of washed gravel and sand mixed with Portland cement in accordance with specification for ASTM C150, Type I or II.

3.2.2.7 Add End Bay Deflectors

The end bay deflectors would be cast-in-place concrete generally consisting of washed gravel and sand mixed with Portland cement in accordance with specification for ASTM C150, Type I or II.

3.2.2.8 Modify Existing Deflectors

The modifications would be cast-in-place concrete generally consisting of washed gravel and sand mixed with Portland cement in accordance with specification for ASTM C150, Type I or II.

3.2.2.9 Bank Stabilization

Riprap would consist of angular rock. Cement grout would consist of washed gravel and sand mixed with Portland cement in accordance with specification for ASTM C150, Type I or II.

3.2.2.10 Bypass Outfall Support Column

Concrete discharged into the interior of the support columns would consist of washed gravel and sand mixed with Portland cement in accordance with specification for ASTM C150, Type I or II.

3.3 Water Salinity, Circulation, and Fluctuation Determinations

3.3.1 Water

The Washington State classification of the lower Snake River from the confluence with the Clearwater River, Idaho, to the confluence of the Columbia River is "Class A," meaning it is of such quality as to qualify for an "Excellent" status [Washington Administrative Code (WAC) 173-201A-030]. Waters of this class meet or exceed certain requirements for multiple uses. Class A requirements include the following:

- water shall not exceed a geometric mean of 100 fecal coliform per 100 milliliters and 10 percent of all samples shall not exceed 200 fecal coliform
- dissolved oxygen shall exceed 8 milligrams per liter (mg/L)
- temperature shall not exceed 20 degrees Celsius (°C)
- pH shall range from 6.5 to 8.5 with a human-caused variation of less than 0.5 units
- turbidity shall not exceed 5 Nephelometric Turbidity Units (NTUs) over background when less than 50 NTUs background or have no more than 10 percent increase over background when the background is higher than 50 NTUs
- concentration of toxic or deleterious material shall not be introduced into the water that has a potential to impair a characteristic use or adversely impact the most sensitive biota dependent upon these waters.

Even though Washington Department of Ecology (Ecology) has classified the water quality of the lower Snake River as excellent, they have placed it on the 303(d) list for temperature and dissolved oxygen (Ecology, 1997).

3.3.1.1 Salinity

At the simplest level, salinity is the amount of dissolved material in grams per one kilogram. This is usually a measurement of metallic or alkaline earth salts of chloride in the water. Natural seawater ranges from 3,460 ppm to 3,480 ppm of dissolved ions. The proportions of the anion (negatively charged ion) and cations (positively charged ion) remain relatively constant. Complex equations have been developed to convert the electrical information into a practical salinity scale that can then be calculated to the mass of salts in seawater. Freshwater concentration of dissolved ions and cations is generally between 100 to 200 ppm of which only about 10 percent is of chloride ion. The ionic composition of freshwaters is dominated by dilute solutions of alkalis and alkaline earth compounds, particularly bicarbonates, sulfates, and chlorides. The amount of silica acid, which occurs largely in un-disassociated form, is usually small, but occasionally they are significant in hard to very hard water.

The salinity of freshwater is best expressed as a sum of the ionic composition of the seven major cations and anions in mass or milliequivalents per liter (Clarke, 1924; Gorham, 1955). This paragraph and later paragraphs discuss specific conductivity because this entire action occurs in freshwater only. Conductivity cannot be a direct relationship to salinity in freshwater because it is not the appropriate unit of measure for the physical characteristic of salinity. Conductivity measures the ability of a compound in an aqueous solution to exhibit electrical resistance or current conductance as measured by a conductivity

bridge cell that is composed of noble metal (usually platinum). In practice, Walla Walla District commonly uses YSI 6600 ugp® sondes to measure conductivity. This instrument is configured to measure many water quality parameters plus depth simultaneously. Therefore, this instrument is the primary workhorse for dredge monitoring activities.

In 1997, the average conductivity in the lower Snake River from River Mile (RM) 6 to RM 129 ranged from 68 microhms to 363 microhms (Appendix C, Water Quality). Re-suspension of sediments can put more of the major ion and cation salts into solution. This action causes an increase in salinity. Other factors such as the release of pollutants, stormwater runoff, and windblown dusts can increase salinity of a body of water. When compared to the ocean, these small changes in salinity, induced by the addition of salts, will result in minute differences when compared on the practical salinity scale. Freshwater biota not accustomed to changes in dissolved salt concentration could be negatively affected by such changes because they lack the capacity to regulate the pressure change associated with osmosis with even small increases of salinity. The Corps has some ion and cation balance data, but that data does not always include temperature, conductivity, or pH data to complement the essential analysis. Identification of baseline salinity and estimation of potential change is difficult in the absence of adequate data. Effects of the discharge of dredged and fill material upon salinity are predicted to be localized, short term, and minimal overall (low).

One YSI 6600 upg® sonde would be placed in the forebay and one YSI 6600 upg® sonde would be placed at the turbine exit of the dam to assess the accuracy of the prediction for RSWs and SBCs, as it relates to salinity. An estimated two sondes would be placed downstream, four sondes alongside, and two sondes upstream of BGSs to assess the accuracy of the prediction as it relates to salinity and the BGSs. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the pier nose extensions to assess the accuracy of the prediction as it relates to pier nose extensions. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the moorage cells and barge access area to assess the accuracy of the prediction as it relates to salinity, moorage cells, and barge access area.

Sondes would collect pH, conductivity, and depth. Backup instrumentation would be on standby at all times. Alkalinity, hardness, and calcium ion analysis would be conducted by titration (a process for determining concentration) before, during, and after construction. Flame photometry or ISE electrodes would be used to measure sodium and potassium. Sulfate ion would be measured by turbidimetric analysis and fluoride ion concentration would be measured by ISE to determine their contribution to salinity changes.

Salinity Gradients

The Practical Salinity Scale is a system for comparing the salinity strength of seawater and brackish with full-strength seawater. However, the Practical Salinity Scale is an inappropriate scale of measure in freshwater systems. The proposed actions would take place in freshwater.

In the absence of a freshwater salinity scale, analysis of ion/cation balance and specific conductivity are generally acceptable for describing quantities of dissolved salts. Unlike seawater, concentrations of salts vary between bodies of freshwater. If sufficient data are collected on individual ion/cation concentration, a correlation to conductivity may be calculated. This correlation would provide a reasonable estimate of salinity for monitoring purposes.

Dredged Material

Removable Spillway Weirs

During construction of the Lower Granite Dam prototype RSW, dredging accounted for only a few microhms of conductivity change. The change in conductivity from background to observable (ΔC) measurement was insignificant in terms of measurable environmental effect upon conductivity. Based on this, any change in conductivity resulting from the discharge of dredged material is also expected to be insignificant.

Behavioral Guidance Structures

A prototype BGS has been constructed at Lower Granite Dam. No field data on the effects of discharges associated with BGSs are available. The effects of the discharge of dredged material associated with BGSs upon salinity and conductivity are expected to be comparable to that identified above for RSWs.

Surface Bypass Collectors

No field data on the effects of discharges associated with SBCs are available. However, the effects of the discharge of dredged material associated with SBCs upon salinity and conductivity are expected to be comparable to that identified above for RSWs.

Sheet Pile Barge Moorage Cells

No field data on the effects of discharges associated with moorage cell construction are available. The effects of the discharge of dredged material associated with moorage cells upon salinity and conductivity are expected to be comparable to that identified above for RSWs. Water samples would be collected and analyzed for ions and cations before, during, and after construction to assess the accuracy of the prediction.

Barge Access Area

No field data on the effects of discharges associated with barge access area construction are available. The effects of the discharge of dredged material associated with construction of the access area upon salinity and conductivity are expected to be comparable to that identified above for RSWs. Water samples would be collected and analyzed for anions and cations before, during, and after construction to assess the accuracy of the prediction.

Pier Nose Extensions

No excavation or discharge of dredged material is anticipated.

Add End Bay Deflectors

No discharge of dredged material is anticipated.

Modify Existing Deflectors

No discharge of dredged material is anticipated.

Bank Stabilization
No excavation or discharge of dredged material is anticipated.

Bypass Outfall Support Column
Materials excavated from the interior of the tightly sealed bypass outfall support columns would be disposed in uplands.

Fill Material

Removable Spillway Weirs
Fill material would likely be pre-cast concrete. No known studies have been conducted to show measurable short-term or long-term changes to conductance in freshwater ecosystems. During construction of the Lower Granite Dam prototype RSW, no ΔC was detected in relation to significant number and instrument error or measurement bias during the short-term monitoring. Based on the results of this short-term monitoring, discharges of fill material associated with RSWs are not expected to affect conductivity.

Behavioral Guidance Structures
The effects of the discharge of fill material associated with BGSs upon conductivity are expected to be comparable to that identified above for RSWs.

Surface Bypass Collectors
The effects of the discharge of fill material associated with SBCs upon conductivity are expected to be comparable to that identified above for RSWs.

Sheet Pile Barge Moorage Cells
The fill material associated with moorage cell construction may contribute to localized short-term impacts on salinity or conductivity. The extent of the effect would be dependent upon the level of salts in the source gravel. Use of washed gravel from a local gravel source would reduce the potential for incorporation of materials having elevated levels of salts. Water samples would be collected and analyzed for anions and cations before, during, and after construction to assess the accuracy of the prediction.

Barge Access Area
The fill material associated with barge access construction may contribute to localized short-term moderate impacts on salinity or conductivity. The extent of the effect would depend on the level of salts in the source gravel. Use of local gravel sources would reduce the potential for incorporation of materials having elevated levels of salts. Water samples would be collected and analyzed for anions and cations before, during, and after construction to assess the accuracy of the prediction.

Pier Nose Extensions

The discharge of cast-in-place concrete fill material would impact salinity if wet concrete comes in contact with or is released into the water. No specific testing of the effects of wet concrete on regional water types has been conducted. Because of the chemical composition of the concrete, significant amounts of anions and cations could be released into the water. In terms of uncertainty and risk, there would be no impact if there were no release. The work would occur in an area dewatered by a temporary bulkhead. This design would minimize the risk of releasing wet concrete into the water. Water samples would be collected and analyzed for ions and conductivity before, during, and after construction to identify effects of accidental releases of wet concrete into the water column and to identify remedial actions.

Add End Bay Deflectors

The effects of the discharge of fill material upon salinity and conductivity are expected to be comparable to that identified above for pier nose extensions.

Modify Existing Deflectors

The effects of the discharge of fill material upon salinity and conductivity are expected to be comparable to that identified above for pier nose extensions.

Bank Stabilization

The effects of the discharge of fill material upon salinity and conductivity are expected to be comparable to that identified above for pier nose extensions.

Bypass Outfall Support Column

The effects of the discharge of fill material upon salinity and conductivity are expected to be comparable to that identified above for pier nose extensions.

3.3.1.2 Water Chemistry

Some of the best data available on Snake River water chemistry are from the USGS in Pasco, Washington. The USGS collected the data near Burbank, Washington, but this station was discontinued in the mid 1990s. Tables 3-1 through 3-7 contain water quality information from the USGS, Station No. 13353200, Snake River at Burbank, Washington and demonstrate previous water chemistries through mid-1990. Little changes in water chemistry are expected to result from construction of RSWs, BGSs, and SBCs. Water chemistry analysis was previously conducted in association with construction of the prototype RSW at Lower Granite. The analysis revealed no measurable change in water chemistry. Possible changes in water chemistry are expected for the pier nose extensions. Measurable water chemistry changes would likely occur in association with construction of the moorage cells and barge access area. Changes are expected to be localized and of short duration. In order to minimize impacts to water chemistry, efforts would be made to control the amount and duration of discharge, minimize discharges, and perform work in the winter months. Water samples would be collected and analyzed for changes in water chemistry before, during, and after construction of the RSWs, BGSs, SBCs, pier nose extensions, moorage cells, and barge access area to assess accuracy of the associated predictions.

3.3.1.3 Clarity

In 1997, Secchi disks and underwater irradiameters were used to determine the transparency of the water and the photic zone. From river mile 6 to river mile 140, the average Secchi transparency ranged from 1.1 to 2.5 meters and the photic zones ranged 3.3 to 5.5 meters (FR/EIS, Appendix C, Water Quality). Some correlation was suggested based on concentrations of total suspended solids (TSS); however, water clarity is frequently useless as a measurement to determine effects to the environment during and after dredge or fill actions. The Secchi disk, while useful during limnological sampling between March and October, only provides a gross estimate of photic zone that could later be loosely correlated to clarity. In freshwaters, clarity is generally important to the study of algal community structure. Eutrophication effects can be related somewhat to water clarity, but effects from this parameter are most commonly measurable as a secondary effect many months later.

For the purpose of the proposed actions, it is expected that initial effects upon clarity would be minor. Water samples would be collected and analyzed for clarity before, during, and after construction of RSWs, BGSs, pier nose extensions, barge moorage cells, and barge access area to assess accuracy of the prediction.

3.3.1.4 Color

Color in water may result from the presence of natural metallic ions (iron and manganese are the most common colorants in natural water), humus (decaying organic material), plankton, weeds, and wastes. Excessive color affects both domestic and commercial uses and may require removal. Water color means the true and apparent color by a chroma analysis and is measured only after all turbidity is removed. A high resolution (upper end) scanning spectrophotometer or tintometer is required to measure true and apparent color. Color values and subsequent changes due to human activities may suggest changes to aesthetic qualities of the surface waters and should not be totally discounted.

Actual true and apparent color is poorly understood in the Snake River Basin. Potential impacts upon color are expected to be minimal. Water samples would be collected and analyzed for color before, during, and after construction of RSWs, BGSs, pier nose extensions, barge moorage cells, and barge access area to assess the accuracy of the prediction.

Appendix T

Table 3-1. Physical Parameters for USGS Water Quality Data, Station No. 13353200, Snake River at Burbank, Washington (Water Year October 1997 to September 1998)

Date	Specific Conductance (µs/cm) (00095)	pH Water Whole Field (Standard Units) (00400)	Temperature Water (°C) (00010)	Turbidity (NTU) (00076)	Oxygen, Dissolved (mg/L) (00300)	Oxygen, Dissolved (% Saturation) (00301)	Hardness Total (mg/L as $CaCO_3$) (00900)	Hardness Noncarb Dissolved Fld as $CaCO_3$ (mg/L) (00904)	Calcium, Dissolved (mg/L as Ca) (00915)	Magnesium, Dissolved (mg/L as Mg) (00925)
Oct. 29, 1997	350	8.1	14.0	1.4	11.4	112	120	3	31	10.0
Dec. 10, 1997	267	8.0	7.0	2.1	11.4	92	89	–	23	7.6
Jan. 28, 1998	339	8.1	4.0	12.0	12.5	96	110	–	29	10.0
Mar. 4, 1998	340	8.2	5.5	2.6	12.8	102	120	8	31	10.0
Apr. 8, 1998	204	8.1	9.0	6.7	12.4	107	72	3	19	6.1
May 7, 1998	156	7.9	14.0	2.9	11.2	110	54	3	15	4.4
May 27, 1998	154	7.8	12.5	7.4	12.6	120	54	–	14	4.5
May 19, 1998	154	7.8	12.5	21.0	12.8	122	53	–	14	4.4
June 22, 1998	146	8.0	17.0	4.1	10.8	113	53	0	15	4.1
July 6, 1998	127	7.8	18.0	4.6	10.2	109	45	–	13	3.3
Aug. 12, 1998	151	7.9	22.5	2.4	9.4	109	53	–	14	4.2
Sept. 3, 1998	174	7.8	22.0	2.4	7.9	92	60	–	16	4.9
Sept. 28, 1998	258	8.0	20.5	1.4	7.7	87	82	–	21	7.0

µs/cm = microsiemens per centimeter
°C = degrees celcius
NTU = Nephelometric Turbidity Unit
mg/L = milligram per liter
$CaCO_3$ = calcium carbonate
Mg = magnesium
Source: USGS, Water Resources Data, Washington. 1998. Report No. WA-98-1.

Appendix T

Table 3-2. Anions and Cations for USGS Water Quality Data, Station No. 13353200, Snake River at Burbank, Washington (Water Year October 1997 to September 1998)

Date	Sodium, Dissolved (mg/L as Na) (00930)	Potassium, Dissolved (mg/L as K) (00935)	Bicarbonate Water Dissolved IT Field mg/L as HCO_3 (00453)	Carbonate Water Dissolved IT Field mg/L as CO_3 (00452)	Alkalinity Water Dissolved Total IT Field mg/L as $CaCO_3$ (39086)	Sulfate Dissolved (mg/L as SO_4) (00945)	Chloride, Dissolved (mg/L as Cl) (00940)	Fluoride, Dissolved (mg/L as F) (00950)	Silica, Dissolved (mg/L as SiO_2) (00955)	Solids, Residue at 180°C Dissolved (mg/L) (70300)
Oct. 29, 1997	21.0	2.9	145	0	119	31.0	12.0	.5	17	211
Dec. 10, 1997	15.0	2.3	109	0	89	21.0	8.8	.4	16	163
Jan. 28, 1998	19.0	2.9	140	0	115	29.0	13.0	.4	19	214
Mar. 4, 1998	20.0	2.7	135	0	111	28.0	12.0	.5	21	199
Apr. 8, 1998	12.0	1.9	84	0	69	15.0	6.8	.3	19	130
May 7, 1998	8.2	1.3	63	0	52	11.0	4.8	.3	15	102
May 27, 1998	8.9	1.7	70	0	57	11.0	4.7	.2	15	101
May 29, 1998	8.8	1.7	67	0	55	11.0	4.6	.2	17	105
June 22, 1998	7.8	1.4	65	0	53	10.0	3.8	.2	13	98
July 6, 1998	6.4	1.3	57	0	47	8.3	3.2	.2	12	88
Aug. 12, 1998	8.6	1.8	66	0	54	11.0	4.4	.3	12	86
Sept. 3, 1998	11.0	1.9	78	0	64	14.0	5.0	.3	13	112
Sept. 28, 1998	18.0	2.8	105	0	86	22.0	8.2	.3	13	161

mg/L = milligrams per liter
NA = sodium
K = potassium
HCO_3 = hydrogen carbonate
CO_3 = carbonate
Ca CO_3 = calcium carbonate
F = fluoride
SiO_2 = silica oxide
°C = degrees celsius
Source: USGS, Water Resources Data, Washington. 1998. Report No. WA-98-1.

Appendix T

Table 3-3. Nutrients for USGS Water Quality Data, Station No. 13353200, Snake River at Burbank, Washington (Water Year October 1997 to September 1998)

Date	Nitrogen, Nitrite Dissolved (mg/L as N) (00613)	Nitrogen, $NO_2 + NO_3$ Dissolved (mg/L as N) (00631)	Nitrogen, Ammonia Dissolved (mg/L as N) (00608)	Nitrogen, Ammonia + Organic Total (mg/L as N) (00625)	Nitrogen, Ammonia + Organic Dissolved (mg/L as N) (00623)	Phosphorus Total (mg/L as P) (00665)	Phosphorus, Dissolved (mg/L as P) (00666)	Phosphorus Ortho, Dissolved (mg/L as P) (00671)	Aluminum, Dissolved (µg/L as Al) (01106)
Oct. 29, 1997	.005	.69	.011	.2	.2	.07	.04	.049	1
Dec. 10, 1997	.004	.58	.010	.1	.1	.03	.02	.034	2
Jan. 28, 1998	.008	1.0	.027	.3	.1	.07	.04	.038	4
Mar. 4, 1998	.005	.99	<.002	.2	.1	.04	.03	.036	3
Apr. 8, 1998	.005	.39	.017	.3	.1	.07	.04	.030	4
May 7, 1998	.004	.22	.006	.2	.1	.03	.01	.015	4
May 27, 1998	.010	.26	.023	.2	.1	.06	.04	.023	5
May 29, 1998	.015	.32	.018	.2	.1	.10	.03	.035	10
June 22, 1998	.003	.14	<.002	.2	<.1	.03	.02	.016	6
July 6, 1998	.002	.11	<.002	.2	<.1	.04	<.01	.016	16
Aug. 12, 1998	.006	.10	.008	.2	.1	.02	.01	.012	2
Sept. 3, 1998	.007	.17	.004	.1	.1	.03	.02	.016	2
Sept. 28, 1998	.005	.28	.003	.2	.2	.05	.06	.028	2

Note: < Actual value is known to be less than the value shown.
mg/L = milligram per liter
N = nitrogen
NO_2 = nitrogen dioxide
NO_3 = nitrate
P = phosphorus
Al = aluminum
µg/L = microgram per liter
Source: USGS, Water Resources Data, Washington. 1998. Report No. WA-98-1.

Appendix T

Table 3-4. Metals for USGS Water Quality Data, Station No. 13353200, Snake River at Burbank, Washington (Water Year October 1997 to September 1998)

Date	Arsenic, Dissolved (µg/L as As) (01000)	Barium, Dissolved (µg/L as Ba) (01005)	Boron, Dissolved (µg/L as B) (01020)	Chromium, Dissolved (µg/L as Cr) (01030)	Copper, Dissolved (µg/L as Cu) (01040)	Iron, Dissolved (µg/L as Fe) (01046)	Lithium, Dissolved (µg/L as Li) (01130)
Oct. 29, 1997	4	31	50.4	2	1	<3	17
Dec. 10, 1997	2	25	36.2	<1	2	<10	10
Jan. 28, 1998	3	33	45.3	3	5	<10	15
Mar. 4, 1998	3	32	46.5	3	7	<10	18
Apr. 8, 1998	2	20	29.7	<1	2	15	10
May 7, 1998	2	17	22.0	<1	1	11	8
May 27, 1998	1	17	24.0	<1	2	<10	7
May 29, 1998	1	17	<16.0	1	2	18	6
June 22, 1998	1	15	18.2	<1	5	<10	6
July 6, 1998	<1	15	<16.0	<1	2	22	7
Aug. 12, 1998	<1	18	<16.0	<1	<1	<10	8
Sept. 3, 1998	2	20	23.3	<1	<1	<10	7
Sept. 28, 1998	3	26	36.5	<1	<1	<10	11

Note: < Actual value is known to be less than the value shown.
µg/L = microgram per liter
As = arsenic
Ba = barium
B = boron
Cr = chromium
Cu = copper
Fe = iron
Li = lithium
Source: USGS, Water Resources Data, Washington. 1998. Report No. WA-98-1.

Table 3-5. Metals and Organic Carbon for USGS Water Quality Data, Station No. 13353200, Snake River at Burbank, Washington (Water Year October 1997 to September 1998)

Date	Molybdenum, Dissolved (µg/L as Mo) (01060)	Strontium, Dissolved (µg/L as Sr) (01080)	Vanadium, Dissolved (µg/L as V) (01085)	Uranium, Natural Dissolved (µg/L as U) (22703)	Carbon, Organic Dissolved (mg/L as C) (00681)	Alachlor, Water, Dissolved (µg/L) (46342)
Oct. 29, 1997	2	180	7	3	2.1	<.002
Dec. 10, 1997	1	140	<6	2	3.2	<.002
Jan. 28, 1998	2	170	<10	2	2.0	<.002
Mar. 4, 1998	2	170	<10	2	1.9	<.002
Mar. 8, 1998	1	110	<10	1	2.7	<.002
May 7, 1998	<1	86	<10	<1	2.4	<.002
May 27, 1998	1	90	<10	<1	2.5	.005
May 29, 1998	1	87	<10	<1	2.9	.005
June 22, 1998	<1	92	<10	<1	2.2	<.002
July 6, 1998	<1	78	<10	<1	2.4	<.002
Aug. 12, 1998	1	92	<10	<1	1.6	<.002
Sept. 3, 1998	1	100	<10	<1	1.9	<.002
Sept. 28, 1998	2	140	<10	2	1.9	<.002

Note: < Actual value is known to be less than the value shown.
µg/L = microgram per liter
Mo = molybdenum
Sr = strontium
V = vanadium
U = uranium
C = carbon
Source: USGS, Water Resources Data, Washington. 1998. Report No. WA-98-1.

Table 3-6. Pesticides for USGS Water Quality Data, Station No. 13353200, Snake River at Burbank, Washington (Water Year October 1997 to September 1998)

Date	Diethyl Atrazine Water Dissolved (µg/L) (04040)	Atrazine Water Dissolved (µg/L) (39632)	DCPA Water Filtered 0.7 µ GF (µg/L) (82682)	P,P' DDE Dissolved (µg/L) (34653)	EPTC Water Filtered 0.7 µ GF (µg/L) (82668)	Metolachlor Water Dissolved (µg/L) (39415)	Metribuzin Sencor Water Dissolved (µg/L) (82630)
Oct. 29, 1997	E.008	.008	E.001	<.006	<.002	.005	<.004
Dec. 10, 1997	E.005	.006	<.002	<.006	<.002	<.002	<.004
Jan. 28, 1998	E.006	<.008	<.002	<.006	<.002	<.002	<.004
Mar. 4, 1998	E.005	.005	<.002	<.006	<.002	<.002	<.004
Apr. 8, 1998	E.002	<.001	<.002	<.006	<.002	<.002	<.004
May 7, 1998	E.002	E.003	<.002	<.006	E.003	<.002	<.004
May 27, 1998	E.003	.007	E.002	<.006	.010	.006	.010
May 29, 1998	<.002	.004	E.002	E.0003	.006	.005	.009
June 22, 1998	<.002	<.001	E.002	<.006	.006	.008	<.004
July 6, 1998	<.002	<.001	<.002	<.006	.010	.004	<.004
Aug. 12, 1998	<.002	<.005	<.002	<.006	<.002	.005	<.004
Sept. 3, 1998	E.004	.006	<.002	<.006	E.003	.007	<.004
Sept. 28, 1998	E.004	.005	E.001	<.006	<.002	.007	<.004

Note: < Actual value is known to be less than the value shown.
E = Estimated
µg/L = microgram per liter
GF = glass filter
Source: USGS, Water Resources Data, Washington. 1998. Report No. WA-98-1.

Table 3-7. Pesticides and Sediment Load for USGS Water Quality Data. Station No. 13353200, Snake River at Burbank, Washington (Water Year October 1997 to September 1998)

Date	Simazine Water Dissolved (µg/L) (04035)	Terbacil Water Filtered 0.7 µ GF (µg/L) (82665)	Triallate Water Filtered 0.7 µ GF (µg/L) (82678)	Sediment, Suspended (mg/L) (80154)
Oct. 29, 1997	<.005	E.006	<.001	4
Dec. 10, 1998	<.005	<.007	E.002	4
Jan. 28, 1998	<.005	<.007	.008	24
Mar. 4, 1998	<.005	<.007	<.001	4
Apr. 8, 1998	<.005	<.007	<.001	10
May 7, 1998	<.005	<.007	<.001	11
May 27, 1998	E.003	E.005	E.004	27
May 29, 1998	<.005	<.007	.010	45
June 22, 1998	<.005	<.007	<.001	13
July 6, 1998	<.005	<.007	<.001	12
Aug. 12, 1998	<.005	<.007	<.001	5
Sept. 3, 1998	<.005	<.007	<.001	4
Sept. 28, 1998	<.005	<.007	<.001	6

Note: < Actual value is known to be less than the value shown.
E = Estimated
µg/L = microgram per liter
GF = glass filter
mg/L = milligram per liter
Source: USGS, Water Resources Data, Washington. 1998. Report No. WA-98-1.

3.3.1.5 Odor

Both the Standard Methods Committee and the American Society for Testing and Materials (ASTM) have controlled odor threshold tests. The Corps has not previously conducted any standardized odor tests on the Snake River; therefore, no prior data is available. During installation of the prototype RSW at Lower Granite Dam in Fiscal Year 2001, no detectable odor was present in water sampled for turbidity.

No changes in odor are anticipated in association with the project. Any unusual odors detected during construction would be investigated.

3.3.1.6 Taste

No ASTM or Standard Method approved taste test data is available. Any potential changes in taste would likely occur as a result of re-suspension of metals. Due to the limited discharge of dredged and fill material, any change in taste would likely be very localized and of short duration.

3.3.1.7 Dissolved Gas Levels

Dissolved gas supersaturation has been one of the major water quality concerns in the Snake River and Columbia River Basins since the late 1960s. Dissolved gas supersaturation is caused when water passing through a dam's spillway carries trapped air deep into the waters of the plunge pool, increasing pressure and causing the air to dissolve into the water. Most spillway discharges affecting dissolved gas levels occur during spring runoff between the months of March and June. The proposed dredged and fill material discharges would occur during the in-water work window of December 15 through March 1. None of the proposed dredged or fill material discharge activities would require the spilling of water; therefore, the discharges would not produce increased levels of total dissolved gas (TDG).

3.3.1.8 Temperature

Based on gas monitoring temperature data collected during 1998 through 2000, the median temperature in the months of December to March ranges from 2°C (35.6°F) to 7°C (44.6°F). Most of the construction would take place when water temperatures are around 4°C (39.2°F) or 5°C (41°F). The proposed actions are not expected to directly or indirectly cause any water temperature change.

3.3.1.9 Nutrients

Nitrogen

Based on 1997 limnological data used in the FR/EIS, the dominant species of nitrogen in the Snake River System are soluble nitrate and nitrite (the measurement is combined when analyzed by cadmium reduction methodology). The portion of nitrite is small because of the well-oxygenated waters. Nitrite is an intermediate oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction of nitrate. In the sediments, denitrification occurs as a result of bacterial decomposition of the nitrate ion. This occurs in a state of anoxia.

The nitrification and denitrification process in the Snake River sediments is not well understood. The sediments contain high amounts of ammonia (60 to 80 ppm), but it is not fully understood how the nitrogen cycle works in the Snake River forebays. No information is available concerning sediment oxygen demand. The lower Snake River had average water nitrate/nitrite levels from 0.13 to 0.35 mg/L of ($NO_2 + NO_3$). Total water nitrogen levels in the lower Snake River ranged from 0.31 to 0.65 mg/L (total-N). The water ammonia levels were near instrument detection limits in some cases or below detection limit (0.007 mg/L N as NH_3). These readings generally indicate nutrients levels are below those typically associated with eutrophic conditions. Water quality data have not been collected during storm events or periods of high flow (spring runoff). It is possible the introduction of large amounts of nitrogen containing nutrients occurs during high flow events. The discharge of dredged material has the potential to increase nutrient levels, which could lead to eutrophic conditions. However, because the discharges would be conducted during winter months and during months of low productivity, any impacts resulting from increased nutrient levels are expected to be localized and of short duration. Water samples would be collected and analyzed for organic nitrogen before, during, and after construction of RSWs, BGSs, pier nose extensions, barge moorage cells, and barge access area to assess accuracy of the prediction.

Phosphorus

The 1997 limnological data identified total phosphorus (TP) as the dominant species. The TP values in the lower Snake River ranged from 0.036 mg /L to 0.067 mg/L TP as phosphate. The ortho-phosphate (ortho-P) in the lower Snake River ranged from 0.013 mg/L to 0.023 mg/L ortho-P as phosphate. Phosphate is essential for plant growth and, when present with other nutrients in abundance, leads to substantial increases in algae growth. When this occurs, deleterious effects from nuisance blooms of blue-green algae increase. Large mats of floating biological material characterize these blooms of blue-green algae. The lower Snake River water quality has degraded significantly by increased nutrient loading since 1974 (Greene, 1995). Greene (1995) determined growth potentials in 1995 Snake River samples were so large that test algae could not reach nitrogen or phosphorus limitation without the assistance of ethylendiamine tetraacetic acid disodium salt (EDTA). No samples from high-flow periods during spring runoff have been analyzed. It is possible that a majority of the phosphorus loading occurs during this time. Concentrations of phosphorus in lower Snake River sediments range from 34 to 38 ppm. Very little is understood about the phosphorus budget of the lower Snake River reservoirs. The discharge of dredged material has the potential to release phosphorus into the water column. Any impacts resulting from increased phosphorus levels are expected to be localized and of short duration because the discharges would be conducted during winter months and during months of low productivity. Small releases of phosphorus should not pose a problem. Water samples would be collected and analyzed for phosphorus parameters before, during, and after construction of RSWs, BGSs, pier nose extensions, barge moorage cells, and barge access area to assess the accuracy of the predictions. Results would be compared and a determination of actual impacts upon phosphorous concentrations would be documented.

Anions and Cations

The most recent ion data for the lower Snake River are 3 years old. The effects of the discharge of dredged and fill material upon anions and cations are expected to be minor and would not deplete concentrations of anions and cations necessary for healthy biota. Water samples would be collected and analyzed for ions before, during, and after construction of RSWs, BGSs, pier nose extensions, barge moorage cells, and barge access area to assess the accuracy of the prediction.

3.3.1.10 Eutrophication

Eutrophic conditions occur when high levels of nutrients occur in conjunction with long photoperiods, greater retention time, and optimal algae growing conditions. These conditions result in massive blooms of algae sometimes considered a nuisance. During these conditions, oxygen is depleted in the lower portions of the water column and releases of undesirable chemical constituents affect aesthetics and quality of the aquatic habitat.

During the winter months, when this action would take place, eutrophic conditions would not be produced due to insufficient light energy and heat budget.

3.3.1.11 Other Effects

There would be some effects caused by re-suspension of nutrient-laden sediment. This is especially a problem in the case of ammonium because of the ammonia-rich sediments and alkaline pH of the water. No data have been collected from the Snake River on ammonia concentrations in the water column in association with the discharge of dredged material. Elutriate tests conducted in 1997 for the FR/EIS

revealed an average of 3 ppm of ammonia due to re-suspension of sediment (Appendix C, Water Quality). This generally indicates re-suspension of ammonia is a year-round concern.

Ammonia would likely be dissolved into the water column with re-suspension of sediments. Effects typically occur less frequently during the winter months; therefore, impacts would likely be minimal. Sediment samples would be collected and analyzed for ammonia before, during, and after construction of RSWs, BGSs, barge moorage cells, and barge access areas to assess accuracy of the prediction. If unionized ammonia exceeds state and Federal limits, work suspension or other actions would be taken to minimize the impacts.

3.3.2 Current Patterns and Circulation

3.3.2.1 Current Pattern and Flow

Removable Spillway Weirs

An RSW passes water through the spillway from a higher elevation in the water column or closer to the surface than the water currently passed from a lower elevation by existing tainter gates. Construction of the RSW is intended to direct the movement of juvenile fish and improve their passage through the lower Snake River dams. Minor changes in flow patterns would occur in the immediate vicinity of an RSW. Overall, no more than a negligible localized effect is expected to occur upon current pattern and flow of the Snake River.

Behavioral Guidance Structures

Changes in flow and current pattern have the potential to affect use of the affected area by aquatic invertebrates and lower food chain organisms. BGSs are expected to have the potential for measurable changes in flow and current. No data on flow and current changes resulting from a BGS are currently available. Flow and current pattern changes resulting from a BGS are expected to be minor and localized. Effects of using the affected area are expected to be minor for both aquatic invertebrates and lower food chain organisms.

Surface Bypass Collectors

SBCs are designed to produce noticeable and desirable changes in flow and current patterns. The changed flow and current patterns attract target species for surface bypass. The effects of these currents have been extensively measured at Lower Granite Dam. The effects to fish from the prototype surface collection system installed at Lower Granite Dam are addressed by Normandeau (2000), and detailed current and flow patterns are described in the Lower Granite Hydroacoustic Evaluation of the Prototype SBC (Corps, 2000). In summary, alterations of flows were found to be very minor, yet beneficial to attracting anadromous fish. Future installations of SBCs would have similar effects upon current pattern and flow.

Sheet Pile Barge Moorage Cells

Moorage cells would be constructed in a low-velocity backwater eddy. This slough-like area is an effect of the pool and is not considered an area that has a large-scale effect upon current and flow patterns of the

Snake River. Placement of individual cells would likely have small-scale effects upon flow patterns and would likely produce measurable changes to flow and current regimes. Effects of small-scale changes in flow and current regimes upon habitat are also expected to be small.

Pier Nose Extensions

Pier nose extensions produce measurable changes in current pattern and flow. An extended pier nose minimizes mixing of water from adjacent spillbays in the vicinity of spillway deflectors. The resulting desired changes in flow and current patterns are locally significant, providing beneficial effects through a reduced potential for elevated TDG levels.

Add End Bay Deflectors

Deflectors cause measurable changes in current pattern and flow by producing a thin discharge jet of water that skims the water surface of the stilling basin. The skimming jet of water prevents the spillway discharge from plunging and entraining air deep into the stilling basin. The resulting desired changes in current pattern and flow are locally significant, providing beneficial effects through a reduced potential for elevated TDG levels.

Modify Existing Deflectors

The existing deflectors would be modified to provide optimal performance based on tailwater elevations and spill discharge parameters of the current voluntary spill program. Effects upon current pattern and flow would be comparable to those identified immediately above for the addition of end bay deflectors.

Bank Stabilization

Placement of riprap and grout would have no more than a negligible effect upon current patterns and circulation.

Bypass Outfall Support Columns

Placement of support columns would likely have small-scale effects upon flow patterns and produce measurable changes to flow and current regimes. Effects of small-scale changes in flow and current regimes upon habitat are expected to be small.

3.3.2.2 Velocity

The discharges of dredged and fill material associated with the recommended plan (preferred alternative) are expected to have no more than a negligible effect upon velocity.

Removable Spillway Weirs

A prototype RSW is currently under construction at Lower Granite Dam. Field data on velocity change resulting from an RSW is not available. Absent an analysis of field data, effects from an RSW upon velocity are expected to be minor and localized.

Behavioral Guidance Structures

A prototype BGS has been constructed at Lower Granite Dam. No field data on the effects of a BGS upon velocity have been collected. Effects of the discharge of fill material are expected to have no more than a negligible effect upon velocity.

Surface Bypass Collectors

No field data on the effects of the prototype SBC at Lower Granite Dam upon velocity have been collected. SBCs are designed to produce noticeable and desirable changes in flow and current patterns within the immediate vicinity of the installation site; however, SBCs are not designed to produce noticeable changes in velocity. Any such changes in the overall velocity of the Snake River are expected to be insignificant and non-measurable.

Sheet Pile Barge Moorage Cells

There is very little measurable current under most conditions in this slackwater area. Acquisition of velocity readings would be difficult due to the slackwater nature of the site. Effects of moorage cells upon velocity are expected to be negligible.

Pier Nose Extensions

The pier nose extensions would produce localized measurable changes in current pattern, but it probably would not affect velocity. Changes in velocity are not expected to be measurable outside of the localized area.

Add End Bay Deflectors

Deflectors would likely produce measurable changes in current pattern, but it probably would not affect velocity. Changes in velocity are not expected to be measurable outside of the localized area.

Modify Existing Deflectors

As previously indicated, the deflectors would be modified to perform optimally under tailwater elevations and spill discharge parameters of the current voluntary spill program. The modified deflectors would continue to produce a skimming flow similar to that produced by the deflectors prior to modification. Changes in current pattern would likely be more prominent than changes in velocity. Resulting changes in velocity are expected to be minor and localized.

Bank Stabilization

Placement of riprap and cement grout should have no recognizable effect upon velocity.

Bypass Outfall Support Columns

Effects of bypass outfall support columns upon velocity are expected to be negligible.

3.3.2.3 Gradient

Stratification in the lower Snake River does not occur because the Lower Snake River Project features run-of-river dams. However, the gradient, in regards to classic eutrophication, is directly caused by a reduction in flow, an increase in retention time, and an increase in ambient temperature. The nutrient-rich sediments release the constituents that are required for plant development, stimulating phytoplankton growth. This growth enhances oxygen depletion and thermal gradient. Conditions are not expected to be conducive to development of eutrophic conditions during construction.

3.3.2.4 Hydrologic Regime

The discharges of dredged and fill material associated with construction of the RSWs, BGSs, SBCs, moorage cells, barge access area, and pier nose extensions would not alter the hydrologic regime. Changes in hydrologic regime are most likely to occur in response to changing weather patterns or changes in the overall management of flows within the lower Snake River System.

3.3.3 Normal Water Fluctuations

The discharges of dredged and fill material associated with the RSWs, BGSs, SBCs, moorage cells, barge access area, and pier nose extensions are expected to have no measurable effect upon normal water fluctuations.

3.3.4 Actions that Would Be Taken to Minimize Impacts

One YSI 6600 upg® sonde would be placed in the forebay, and one YSI 6600 upg® would be placed at the turbine exit of the dam to assess the accuracy of the predicted impacts regarding salinity for RSWs and SBCs. An estimated two sondes would be placed downstream, four sondes alongside, and two sondes upstream of the BGSs to assess the accuracy of the prediction as it relates to salinity and the BGSs. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the pier nose extensions to assess the accuracy of the prediction as it relates to pier nose extensions. One sonde would be placed in the forebay, and 12 sondes would be placed in a grid array downstream of the moorage cells and the barge access area to assess the accuracy of the prediction as it relates to salinity, the moorage cells, and the barge access area. Sondes would collect pH, conductivity, and depth. Backup instrumentation would be on standby at all times. Alkalinity, hardness, and calcium ion analyses would be conducted by titration before, during, and after construction. Flame photometry or ISE electrodes would be used to measure sodium and potassium. Sulfate ion would be measured by turbidimetric analysis and fluoride ion concentration would be measured by ISE to determine their contribution to salinity changes.

Water samples would be collected and analyzed for ions and cations before, during, and after construction of moorage cells and the barge access area to assess the accuracy of the predicted impact upon salinity.

Washed gravel, used as fill material in construction of moorage cells and the barge access area, would be obtained from a local gravel source to reduce the potential for incorporation of materials with elevated levels of salts. This approach would minimize potential impacts to salinity and conductivity.

Water samples would be collected and analyzed for ions and conductivity before, during, and after construction of pier nose extensions, and deflector additions and modifications to identify effects of accidental releases of wet concrete into the water column and to identify remedial actions.

Controlling the amount and duration of discharge, minimizing discharges, and performing work in the winter months would help minimize impacts to water chemistry. Water samples would be collected and analyzed for changes in water chemistry before, during, and after construction of the RSWs, BGSs, SBCs, pier nose extensions, deflector additions and modifications, moorage cells, and barge access area to assess accuracy of the associated predicted impacts.

Water samples would be collected and analyzed for clarity, color, organic nitrogen, phosphorus parameters, and ions before, during, and after construction of RSWs, BGSs, pier nose extensions, deflector additions and modifications, barge moorage cells, and barge access area to assess accuracy of the predicted impact.

Sediment samples would be collected and analyzed for ammonia before, during, and after construction of RSWs, BGSs, SBCs, pier nose extensions, barge moorage cells, and barge access area to assess accuracy of the predicted impact.

3.4 Suspended Particulate/Turbidity Determinations

A colloidal or suspended matter composition of very fine organic and inorganic matter, clays, microorganisms, and plankton causes turbidity in water. Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted with no change or flux level through the sample. The standard unit of measurement is the NTU, which references the instrument calibrated to measure the property using a standardized hydrazine sulfate/hexamethylenetetramine suspension (APHA, 1998). Correlation of turbidity with the mass or particle number concentration of suspended matter is problematic due to differences in size, shape, and refractive indices affecting the light scattering of a suspension. The cause-and-effect relationship to the aquatic environment is a direct effect of suspended sediment loads blocking light and, in some cases, altering the specific gravity of the water when the total dissolved solids fraction increases.

The non-scientist often confuses turbidity with the particle mass density measurement called TSS. Suspended particle or sediment load is composed of fine particles consisting primarily of inorganic materials of sufficient size and mass to settle quickly when kinetic energy (flow) decreases enough for the mass of the particle to fall out of suspension. The literature suggests there are direct correlations between suspended sediment load and fish feeding. Lloyd (1985) lists several studies spanning three decades where increased sediment load resulted in decreases of salmonid feeding. Noggle (1978) looked at the physiological effects to gill tissue in salmon exposed to high loads of suspended sediment. Most of the conclusions were that the fish only had damaged gills when extreme quantities of sediment were suspended in test waters. He also concluded that feeding was most affected in the moderate and lower levels of suspended particles and turbidity.

The use of mixing zones in monitoring and enforcement of sediment and turbidity standards seeks to accommodate the temporal suspension effects of larger size particles. While a single relationship between turbidity measurements and suspended sediment concentration may not be extremely accurate for the wide diversity of streams and rivers, the impacts caused by levels of the suspended particles can often occur with an increase in turbidity. The practicality of rapid measurement of suspended sediment quantity by drying at constant temperature followed by precision weighing is difficult at best. The ease and accuracy for which turbidity can be measured in the field has prompted many regulators to develop turbidity criteria instead of suspended sediment criteria.

Turbidity measurements collected after installation of a prototype RSW at Lower Granite Dam demonstrated little measurable effect to the river system. The mean turbidity for this project was within the parameters of the 401 Certification during the construction activities. The particle size determinations, as mentioned earlier, showed most of this area to be primarily silt.

3.4.1 Expected Changes in Suspended Particulate and Turbidity Levels in the Vicinity of the Site

A short-term increase in turbidity would likely occur in the immediate area of the proposed actions. For the RSWs, BGSs, and SBCs, there would likely be very small increases in turbidity caused from the dredged material discharge and the placement of the pre-cast concrete fill material. These three actions would require a small dilution zone. Once the water from these upstream actions enters the powerhouse turbines, the mixing of the powerhouse flow would likely only produce minor turbidity increases downstream.

One YSI 6600 upg® sonde would be placed in the forebay and one YSI 6600 upg® sonde would be placed at the turbine exit of the dam to assess the accuracy of the prediction for RSWs and SBCs, as it relates to turbidity. An estimated two sondes would be placed downstream, four sondes alongside, and two sondes upstream of BGSs to assess the accuracy of the prediction as it relates to turbidity and the BGSs. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the pier nose extensions to assess the accuracy of the prediction as it relates to pier nose extensions. One sonde would be placed in the forebay, and 12 sondes would be placed in a grid array downstream of the moorage cells and barge access area to assess the accuracy of the prediction as it relates to turbidity, moorage cells, and barge access area.

Sondes would collect turbidity and depth 24 hours per day, 7 days per week. Backup instrumentation would be on standby at all times. Secondary readings would be taken using a Hach 2100 P nephelometer for quality assurance/quality control (QA/QC). The data would be provided to Ecology, if requested.

Provided there is no release of wet concrete into the water outside of the tightly sealed forms, no measurable turbidity is expected to be produced by the installation of the spillway pier nose extensions, the additions and modifications of the deflectors, and the bypass outfall support columns. The tightly sealed forms would be dewatered prior to the discharge of concrete by pumping the water out and into the Snake River. Minor releases of wet concrete into the water located within the area dewatered by the bulkhead may occur incidentally. During and following the discharge of concrete, the area behind the bulkhead would be dewatered by pumping the water out for upland disposal. Effects of the potential incidental releases are predicted to be negligible. Turbidity would be monitored during construction of pier nose extensions to assess the accuracy of this prediction. Monitors would be placed downstream of bulkheads used to dewater pier nose extension construction sites. Readings would be routinely collected for use in assessing impacts and identifying work methods for minimizing potential impacts. If, during discharge activity, turbidity levels at the monitoring site exceed 5 NTUs over background turbidity when the background turbidity is 50 NTUs or less; or, if turbidity levels at the monitoring site increase by more than 10 percent when the background turbidity is more than 50 NTUs, discharge activity would temporarily cease until turbidity levels at the monitoring site returned to levels within these limits.

The discharge of substrate material excavated from within the interior of the moorage cells into the water would increase turbidity levels above background. This discharge of dredged material has the potential to cause minor to major turbidity increases. Washed gravel would be discharged into the constructed moorage cell. This discharge of gravel fill material would not directly introduce sediments or increase

turbidity outside the cell; however, some turbid water would likely be forced out of the cell as the gravel fill displaces it.

The introduction of the turbid water into the water column of the Snake River would increase turbidity beyond background. The increase in turbidity resulting from introduction of the turbid water is predicted to be minimal.

Monitoring would be conducted to assess the accuracy of this prediction. If, during in-water excavation and discharge activity, turbidity levels at the monitoring site exceed 5 NTUs over background turbidity when the background turbidity is 50 NTUs or less; or, if turbidity levels at the monitoring site increase by more than 10 percent when the background turbidity is more than 50 NTUs, in-water excavation and discharge activity would temporarily cease until turbidity levels at the monitoring site returned to levels within these limits.

The excavation of riprap to facilitate construction of the bulkhead for the barge access area would likely increase turbidity levels beyond background. The excavated riprap would be disposed in uplands. Washed gravel would be discharged behind the constructed bulkhead. This discharge of gravel fill material would not introduce sediments or increase turbidity outside the bulkhead; however, some turbid water may be forced out of the area behind the bulkhead as it is displaced by the gravel fill. The introduction of the displaced turbid water into the water column would increase turbidity levels beyond background. The increase in turbidity resulting from introduction of the turbid water is expected to be minimal.

Monitoring would be conducted to assess the accuracy of this prediction. If, during in-water excavation and discharge activity, turbidity levels at the monitoring site exceed 5 NTUs over background turbidity when the background turbidity is 50 NTUs or less, or if turbidity levels at the monitoring site increase by more than 10 percent when the background turbidity is more than 50 NTUs, in-water excavation and discharge activity would temporarily cease until turbidity levels at the monitoring site returned to levels within these limits.

3.4.2 Effects (Degree and Duration) on Chemical and Physical Properties of the Water Column

The latest information from the 1997 sediment evaluation in the Snake River (Anatek Labs, 1997) describes sediments that are relatively clear of pesticides and herbicides. There are some metal concentrations in these forebay areas above the background levels. These include barium, manganese, zinc, and sometimes mercury. Copper is a concern because of its use as an agricultural chemical and its synergistic effect of toxicity to aquatic life with zinc. The metals themselves are transient (just as the sediments are) and must be re-tested every 5 years to assess the impacts they could pose.

3.4.2.1 Ammonia

Potential risk of impacts of actions involving excavation and in-water disposal upon ammonia in the Lower Granite Lake are judged to be extremely high because the elutriate ammonia average (3.6 mg/L at 8.5 pH) could exceed the early life stage criterion three-fold. The elutriate ammonia average could also exceed both acute criterions (2.14 mg/L and 3.20 mg/L). Potential impacts upon ammonia in the Little Goose, Lower Monumental, and Ice Harbor reservoirs are judged to be moderate because the elutriate ammonia average could exceed the chronic early life stage criterion. Duration of localized effects would be short because of diffusion of the dissolved ammonia. Dissolved ammonia would remain in solution for

a considerable amount of time because of temperature and inactivity of microbes that reduce the ammonia to nitrogen gas.

3.4.2.2 Manganese

As indicated in Section 3.2 above, manganese is present in each of the four lower Snake River reservoirs. Because a small quantity is released over a short period, there is a good chance there would be a very minor localized effect of lower dissolved oxygen in the immediate area.

3.4.2.3 Mercury

Excavation and sidecasting of sediments could liberate mercury from the sediments allowing it to elutriate into the water column. Data in the FR/EIS and in Appendix C, Water Quality on the amount of mercury in the sediment and the amount of mercury elutriated suggests 100 percent of mercury found in sediments would be dissolved and any localized effects of mercury would be short term. Any long-term effects would be cumulative in nature because of mercury's propensity to bio-accumulate.

3.4.2.4 Zinc

Localized acute effects of zinc would be short term due to the effects of diffusion and water hardness. The degree of effect could range from minor to major, depending upon the amount of exposure. Juvenile salmonids have the lowest resistance to acute and chronic exposure to zinc (EPA, 1976). Any long-term effects would be cumulative in nature because of zinc's propensity to bio-accumulate.

3.4.2.5 Copper

Localized acute effects of copper would be short term due to the effects of diffusion and alkalinity. The degree of effect could be major, depending upon the amount of exposure. Copper is more toxic at lower concentrations than zinc and is reported to have a synergistic effect with zinc (EPA, 1976).

3.4.2.6 Tetrachlorodibenzo-p-dioxin and Tetrachlorinated Dibenzo Furans

The potential of disturbing sediment containing tetrachlorodibenzo-p-dioxin (TCDDs) and tetrachlorinated dibenzo furans (TCDFs) is expected to be minimal. If, however, sediments containing 2378-TCDD and 2378 TCDF were encountered, the effects could be major and long term.

3.4.2.7 Turbidity

Discharges of dredged and fill material associated with the proposed action would increase turbidity levels above background. The effects of the discharges and actions to minimize their impacts are presented in Section 3.4 above.

3.4.3 Effects on Biota

3.4.3.1 Primary Production, Photosynthesis

In temperate lakes, both biomass and productivity of phytoplankton is usually low (Wetzel, 1983). Where nutrients are adequate, the growth is still limited to species that are adapted to low temperatures and low irradiance. In Indiana, a very significant portion of the total annual primary productivity occurs in some lakes during the winter months (Wetzel, 1966). Similar values have been found in other temperate lakes, emphasizing the widely held assumption that winter productivity is insignificant. This assumption is not

universally valid. No data exist about chlorophyll *a* concentrations during the winter months or algal populations of the lower Snake River.

Significant activities that increase turbidity can seriously affect winter primary productivity. There may be little margin for unaffected loss of irradiance with winter-adapted species of phytoplankton. This could have some secondary effects to primary productivity. Although turbidity could impact primary productivity, no more than negligible impacts are expected due to planned actions to minimize impacts.

3.4.3.2 Suspension/Filter Feeders

Rotifers

The cycle of rotifers is characterized by large numbers of generations in which reproduction is parthenogenic. The amictic females produce eggs that are all diploid. The diploid egg production is broken once or twice per year by the production of mictic females. These haploid females produce haploid eggs that, if fertilized by a male, become resting eggs that over-winter. These eggs are usually hatched as a result of temperature and chemical changes in the water. These resting eggs are resistant to harsh environmental conditions.

Aside from resuspending, these eggs would probably survive most construction impacts. Some eggs may be entrained into the structures. This construction effort entails less than 1/100th of a percent of the available area in the pool. Given existing technology, measurable effect to the rotifer population is expected to be insignificant.

Cladocera

In many ways, the cladocera produce parthenogenic offspring until environmental conditions require sexual versions to be produced. In cladocera, the changes are linked to food quality as much as they are to light and temperature. Some of the resting eggs of cladocera tend to float in the proposed construction areas. Movements of large floating plant equipment could trap and destroy some of the resting eggs. Effects upon cladocera as well as the overall population are expected to be negligible.

Copepods

Little is known about copepods and their seasonal fluctuations in the lower Snake River System. Copepods are not studied as widely as cladocera because of the importance of cladocera as food for planktivorous fish. Copepods are an important link in the ecosystem because of their abundance and diversity.

During the construction work window of December 15 through March 1, copepods exist primarily in a resting stage. During this stage, copepods are more resilient. The proposed action is expected to have no more than a minimal effect upon copepods.

3.4.3.3 Sight Feeders

Salmon and centrarchid fish are known to feed on zooplankton by sight. The dynamics of wintering zooplankton and the interactions of fish are poorly understood in the Snake River System. Typically in freshwater systems, primary productivity decreases during the winter months because of decreases in periods of sunlight and in temperature. As a result, zooplankton decreases, causing sight feeders to alter

feeding habits to more benthic-oriented prey items (e.g., snails, worms, etc.). In addition, the activity and metabolism of poikilothermic organisms (including sight feeders) tends to slow with decreases in temperature, resulting in lower feeding rates.

Because the disposal of dredged and fill material would occur during the in-water work window of December 15 through March 1, when water temperature is low and feeding rates reduced, the potential impact upon sight feeders is expected to be negligible. Also, all salmonids should have migrated out of the lower Snake River during the in-water work window except for a small percent of remnant holdover juvenile spring/summer chinook salmon, fall chinook salmon, or over-wintering juvenile steelhead. In addition, the dredging and disposal process may benefit sight feeders by exposing and redistributing benthic prey items from below the substrate to where fish may have access to them.

3.4.4 Actions Taken to Minimize Impacts

One YSI 6600 upg® sonde would be placed in the forebay and one YSI 6600 upg® sonde would be at the turbine exit of the dam to assess the accuracy of the prediction for RSWs and SBCs, as it relates to turbidity. An estimated two sondes would be placed downstream, four sondes alongside, and two sondes upstream of the BGSs to assess the accuracy of the prediction as it relates to turbidity and the BGSs. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the pier nose extensions to assess the accuracy of the prediction as it relates to pier nose extensions. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the moorage cells and barge access area to assess the accuracy of the prediction as it relates to turbidity, the moorage cells, and barge access area.

Sondes would collect turbidity and depth 24 hours per day, 7 days per week. Backup instrumentation would be on standby at all times. Secondary readings would be taken using a Hach 2100 P nephelometer for QA/QC.

Turbidity would be monitored 300 feet downstream of the dam during in-water excavation and discharge activities associated with construction of RSWs, BGSs, SBCs, sheet pile barge moorage cells, and the barge access area. In accordance with WAC 173 201A-030, if, during in-water excavation and discharge activity, turbidity levels at the monitoring site exceed 5 NTUs over background turbidity when the background turbidity is 50 NTUs or less; or, if turbidity levels at the monitoring site increase by more than 10 percent when the background turbidity is more than 50 NTUs, in-water excavation and discharge activity would temporarily cease until turbidity levels at the monitoring site returned to levels within these limits.

3.5 Contaminant Determinations

The purpose of contaminant determinations is to determine the degree to which the proposed discharges would introduce, relocate, or increase contaminants. Under the general framework of Section 404 of the Clean Water Act, testing of excavated material is conducted to assist in making factual determinations regarding the effect of the discharge on the aquatic ecosystem and in determining whether the discharge will comply with the 404(b)(1) Guidelines (40 CFR 230.10 and 230.11). The 404(b)(1) Guidelines provide for testing under certain circumstances. Suggested protocols for testing, when determined appropriate under 40 CFR 230.60 and 230.61, are outlined in the Inland Testing Manual, February 1998, developed jointly by the Corps and the EPA. The Inland Testing Manual facilitates testing in conjunction with proposed dredged material discharges resulting from navigation dredging.

The chemicals of concern (CoC) for the proposed activity are identified in the FR/EIS, Appendix C, Water Quality. The following discussion addresses CoCs and other contaminants. Each of the four lower Snake River reservoirs are discussed because there are slight variations for each pool. CoCs identified in Appendix C are ammonia, manganese, dioxin toxicity equivalents (dioxin TEQ), and total dichloro-diphenyl-trichloro-ethane (DDT). Other possible contaminants discussed below include: mercury, zinc, copper, turbidity, wet concrete, rinse water from gravel fill, and the congeners TCDD and TCDF.

3.5.1 Dredged Material

In all cases except one, the excavated material would be sidecast immediately adjacent to the extraction site. The exception is that riprap excavated to construct the barge access area would be disposed in uplands.

3.5.1.1 Effects from Ammonia

Ammonium (NH_4+) itself is generally only toxic in large concentrations. It is the un-ionized portion of ammonia (NH_3) that is toxic to aquatic life (Downing and Merkens, 1955). Un-ionized ammonia is more toxic because it is a neutral molecule and, thus, has the ability to diffuse across the epithelial membranes of aquatic organisms far more readily than a charged ion. Ammonia is a byproduct of the organism's biological processes and must be excreted. High external un-ionized ammonia concentrations reduce or reverse diffusive gradient and cause the buildup of ammonia in gill tissue (EPA, 1999). Tabata (1962) and Armstrong et al. (1978) postulated that, assuming ammonia and un-ionized ammonia have different partial toxicity, the un-ionized ammonia was 100 times more toxic than ionized ammonia. In studies done by Tabata (1962) and Armstrong et al. (1972), they found that un-ionized ammonia toxicity had a measurable correlation to pH. Nimmo et al. (1989) conducted studies with Johnny darters in river water and juvenile fathead minnows that resulted in LC 50s in terms of un-ionized ammonia increasing from factors of 3.5 to 6.2 with increasing temperatures. Johnson (1995) investigated the effect of pH on chronic toxicity of ammonia on *Ceriodaphnia dubia* in test waters of three different ionic compositions. In all three waters, LC 50s expressed in terms of un-ionized ammonia increased with increasing pH; however, unlike Ankley et al. (1995), the pH dependence was greater in waters with higher rather than lower hardness.

As indicated in Section 3.2 above, ammonia is present in each of the four pools of the lower Snake River. The potential for impacts due to ammonia is likely to occur when sediments associated with ammonia are resuspended. The concentration of ammonia in the sediments, when compared to the potential amount of dissolved ammonia, makes excavation of sediments in the summer undesirable because the amount of un-ionized ammonia increases as water temperature increases. Un-ionized ammonia also increases dramatically when levels exceed 7.5 pH.

Table 3-8 presents an evaluation of pH-induced impacts upon ammonia levels using existing data. Waters of the Snake River are typically between pH 7.8 and 8.5, and therefore are high in alkalinity. Sediments excavated and sidecast would contain levels of ammonia considered to be relatively high. Elutriation tests were previously conducted to obtain estimates of ammonia dissolved in the water (FR/EIS, Appendix C, Water Quality). Table 3-8 compares elutriation data to average concentrations of sediment ammonia for each pool, to average pool pH, and to the National Criterion for Ammonia in Fresh Water (EPA, 1999). The elutriate ammonia averages in mg/L for Lower Granite, Little Goose, Lower Monumental, and Ice Harbor are 3.6 mg/L, 2.6 mg/L, 2.5 mg/L and 3.6 mg/L, respectively (Anatek Labs, 1997). An assessment, based on chronic and acute criterion for fish (EPA, 1999), was then conducted.

Potential impacts of actions involving excavation and in-water disposal upon ammonia in the Lower Granite reservoir are judged to be extremely high because the elutriate ammonia average (3.6 mg/L at 8.5 pH) could exceed the early life stage chronic criterion three-fold. The elutriate and ammonia average could also exceed both acute criterions (2.14 mg/L and 3.20 mg/L). Potential impacts upon ammonia in the Little Goose, Lower Monumental, and Ice Harbor reservoirs were judged to be moderate because the elutriate ammonia average could exceed the early life stage chronic criterion.

Table 3-8. Potential Ammonia Levels of Resuspended Sediment upon Fish

	Lower Granite	Little Goose	Lower Monumental	Ice Harbor
Elutriate ammonia average (mg/L)	3.6	2.6	2.5	3.6
Dissolved elutriate percentage (%)	4.7	4.0	4.2	4.4
Average forebay concentration of ammonia (mg/kg)	75.7	64.3	59.6	81.3
Average pH in winter	8.5[1/]	8.3[2/]	8.1[3/]	8.0[4/]
Early life stage chronic criterion (mg/L)	1.09	1.52	2.10	2.43
Acute criterion with salmon present (mg/L)	2.14	3.15	4.64	5.62
Acute criterion with salmon absent (mg/L)	3.20	4.71	6.95	8.40
Predicted risk of impact	Extremely High	Moderate	Moderate	Moderate

1/ Data source: Prototype BGS Installation at Lower Granite
2/ Data source: Estimated pH from previous unpublished data
3/ Data source: Corps. 1998 LSRF Data
4/ Data source: Anatek Labs, 1997

Monitoring of ammonia concentrations would be conducted during construction to assess the accuracy of the predictions. If, during discharge activities, ammonia levels at monitoring sites exceed state and Federal limits, discharge activities would temporarily cease until ammonia levels at monitoring sites returned to levels within state and Federal limits.

3.5.1.2 Effects from Manganese

The literature suggests that excessive dissolved manganese is only a concern for commercial and domestic water supplies. With the exception of the lower Snake River, most natural waters are usually well below 1,000 µg/L (Thurston et al., 1979). Actual toxicity of manganese to aquatic life is not well documented. Some documentation exists suggesting that the 1997 eluate may be tolerated by most freshwater organisms (McKee and Wolf, 1963). Morgan (1967) described how different compounds of manganese use differing concentrations of oxygen based on the alkalinity (measured by sodium hydroxide). He showed there was a rapid consumption of oxygen within 10 to 20 minutes followed by an extended period of very slow oxygen uptake. This demonstrates the potential for anaerobic sediment, suddenly released in the alkaline water column with manganeous salts, to rapidly scrub dissolved oxygen in the solids suspension. While the manganese has no direct effect on the environment, the loss of dissolved oxygen does provide a potential secondary effect.

As indicated in Section 3.2 above, manganese is present in each of the four lower Snake River reservoirs. Because a small quantity is released over a short period, there is a good chance there would be a minor localized effect of lower dissolved oxygen in the immediate area.

3.5.1.3 Effects from Dioxin TEQ

A thorough understanding of the relevant toxicity of 2,3,7,8- tetrachlorodibenzo-p-dioxin (2378-TCDD) is necessary to assess toxicity equivalence quantity (TEQ). There are 210 dioxin and furan congeners. Seventeen of these congeners are toxic. The isomer 2378-TCDD is the most toxic of the 17 toxic congeners of dioxin and furans. Dioxin TEQ refers to the mathematical operation of converting the toxicity of a congener to the toxicity of TCDD. There are 75 different TCDD congeners, or forms, of which 2378-TCDD (commonly referred to as dioxin) is the most toxic and widely studied. TCDFs are chemically similar to TCDDs and occur in 135 forms.

The TCDDs and TCDFs with chlorine atoms located at the 2,3,7, and 8 positions are considered to be the most toxic. There are 7 TCDDs and 10 TCDFs with this substitution pattern. To assess the toxicity of TCDD/TCDF mixtures in fish, a set of toxicity equivalence factors (TEFs) are used to convert toxicity of each congener to that of 2378-TCDD, called toxicity equivalents, or TEQs (Barned et al., 1989). Calculation of TEQ for a hypothetical fish sample containing 5 parts per trillion (ppt) TCDD and 23 ppt TCDF (considered to be 1/10 as toxic as TCDD, giving it a TEF of 0.1) is as follows: $[5 + (0.1 \times 23)] =$ 7.3 ppt TEQ.

The U.S. Food and Drug Administration (Hall, 1981) has advised that TCDD concentrations less than 25 ppt are little cause for human health concern. Ecology, on the other hand, uses a criterion of 0.07 ppt TCDD in fish tissue to assess violations of state surface water quality standards. This value is based on an increased lifetime cancer risk of 1 in 1 million and is derived from the EPA health criterion for TCDD of 0.013 parts per quadrillion in water and a bioconcentration factor of 5,000 (EPA, 1986).

TCDDs and TCDFs are relatively insoluble (less than one part per billion in water) and have a high octanol/water partition coefficient, defined as the ratio of a compound's concentration in n-octanol to water in an equal mixture of the two solvents (Crummett and Stehl, 1973; Smith et al., 1988). These characteristics cause it to be sequestered in the fatty tissues of organisms and adsorbed to carbon-containing sediment in the aquatic environment (Maybee et al., 1991; EPA, 1984; Opperhuizen and Sijm, 1990). Decomposition of TCDDs and TCDFs in the aquatic environment may be a very slow process. Half-lives of these compounds in sediments are probably greater than 1 year, and may be 10 years or more for TCDD (Eisler, 1986; Environment Canada/Health and Welfare Canada, 1990).

Effects from 2378-TCDD and TCDF

TCDD and TCDF are persistent toxic substances that enter the environment as unintended byproducts of several industrial processes. They represent a hazard to aquatic life and human health because of their toxicity at low levels, persistence, and bioaccumulation factors (National Resources Council Canada [NRCC], 1981; Eisler, 1986). The most significant sources are pulp mills, municipal waste incinerators, and fires involving polychlorinated biphenyl (PCB)-contaminated oil (EPA, 1984; Palmer et al., 1988). Other potential sources of deposition include open burning of household waste in barrels (Lemieux et al., 2000). The EPA (1993) considers dioxin-like compounds to be carcinogens.

TCDD and TCDF have low solubility in water; less than 1 parts per billion (ppb) (Crummet and Stehl, 1973). When discharged to aquatic environments, their primary fate is sorption to the sediments and

accumulation in biota (Johnson et al., 1991). Concentrations in fish can exceed environmental concentrations by factors as high as more than 5,000 because of this solubility by lipid tissue (Maybee et al., 1991; EPA, 1984; Opperhuizen and Sijm, 1990).

Since the 1980s, there have been concerns about dioxin/furan contamination of the Washington portion of the Snake River. These concerns arose when 2378-TCDD was found in the effluent of bleached Kraft pulp mills in the United States. In 1999, there was no 2378-TCDD detected in the Lower Granite sediment sample sites (CH2M HILL, 1999). In 1991, in response to the dwindling salmon stocks on the Snake River, the Corps initiated a sediment quality study to attempt identification of potential sediment/contaminant factors that could be associated with mortality. Five of 19 sediment composite samples analyzed for dioxin/furan compounds averaged 0.43 ppt 2378-TCDD and 2.72 ppt 2378-TCDF (Pinza et al., 1992).

In 1994, the Corps conducted sediment and water quality studies to determine the extent of contamination from various non-point sources (particularly storm water runoff). Results from dioxin furan analysis yielded 0.68 ppt 2378-TCDD and 1.34 ppt 2378-TCDF in the Corps' east pond. An inlet stream into the east pump pond yielded 4.56 ppt 2378-TCDD and 68.6 ppt 2378-TCDF (MRI, 1994).

In 1998, prior to confluence dredging, the Corps initiated a sediment study in which nine samples were collected in the confluence area of the Snake and Clearwater Rivers. Only two of the nine samples yielded a result with 1.3 and 1.7 ppt 2378-TCDF and no detect for 2378-TCDD.

CH2M HILL conducted dioxin tests in the Lower Granite reservoir and in the Clearwater arm of the reservoir. Seven sites were selected and individual sub-sets were combined into a composite sample for analysis. All of the in-river site sample results showed no detects and below detection limits for 2378-TCDD and 2378-TCDF. The only sample that contained detectable levels of contamination was the Corps' east pond (CH2M HILL, 1999). The contamination results for 2378-TCDD and 2378-TCDF were very low (2.8 ppt and 34 ppt, respectively). The east pond receives storm runoff from multiple sources. CH2M HILL again repeated the study in 1999 and discovered the only detection was for 2378-TCDF in the amount of 23 ppt.

Potential impacts of disturbing sediment containing TCDDs and TCDFs are expected to be minimal. As indicated in the text above, concentrations of TCDDs and TCDFs primarily occur above Lower Granite Dam. Sampling conducted in 1999 (CH2M HILL, 1999) above and below Lower Granite Dam resulted in "no detect" or "below detection limits" for 2378-TCDD and 2378 TCDF.

3.5.1.4 Total DDT

DDT is an organochlorine pesticide. Several organochlorine pesticides were detected in the sediment samples collected from the lower Snake River. Three principal organochlorine pesticide compounds detected in the sediments are related; DDT being the parent compound and DDD-DDE being daughter products generated by the transformation of DDT in the environment (Callahan et al., 1979).

The military developed and produced DDT during World War II to control mosquitoes and, thereby, the spread of malaria and other diseases. Released into civilian markets in 1945, DDT was used heavily over the next 2 decades to control agricultural and forest insects as well as disease vectors. By 1961, 1,200 formulations of DDT were available for use on 334 crops (EPA, 1992). The DDT was also used to control fishes, bats, and other wildlife. After World War II, additional organochlorine pesticides including methoxychlor, aldrin, dieldrin, and chlordane became available. These were followed in the

1950s and 1960s by endosulfan, endrin, mirex, kepone, toxaphene, and others (Smith, 1991). In addition to being highly toxic, organochlorine pesticides are relatively insoluble in water, adhere strongly to soil particles, and are resistant to physical, chemical, and biological degradation. These properties were viewed as desirable, and negative consequences from bioaccumulation and toxicity to nontarget organisms were not foreseen.

The ecological consequences of organochlorine pesticides were extensive, and some remain evident. Many organochlorine compounds bioaccumulate because of their insolubility in water and resistance to complete metabolic degradation. Upon accumulation by vertebrates, DDT is metabolized to DDE, which is stable and toxic; it impairs calcium metabolism in the shell gland of adult female birds. At sufficiently high concentrations, eggshell thickness can be reduced to the extent that eggs cannot support the weight of the incubating parents. As thickness decreases, the shell can break and death of the developing embryo can result. Susceptibility varies, but predatory birds are most vulnerable for two reasons; 1) physiologically and 2) their position at the apex of aquatic food chains (Cooke, 1973).

It was expected that no organochlorine pesticide would be present in the sediments tested during the special sediment study of 1997 for the Feasibility Study. In response to the dramatic decline in use of the organochlorine pesticides, other researchers reported sharp drops in the detection of these compounds (Mineau and Peakall, 1987; Prouty and Bunck, 1986; Bunck et al., 1987; Baumann and Whittle, 1988; Schmitt et al., 1990; Wiemeyer et al., 1993; Weseloh et al., 1994; Mora, 1995). Therefore, no contamination was expected because of the length of time since the use of these products. This study was considered to be a benchmark of 20 years after phase-out of these compounds. To the contrary, organochlorine pesticide residues were detected in the sediments of all the four lower Snake River reservoirs.

The predominant organochlorine compound detected was DDE, which ranged in average concentration from 2.68 in Ice Harbor to 6.48 in the Lower Granite reach, with an arithmetic mean concentration of 4.89 ppb. DDD was detected in 11 sediment samples, with an average maximum concentration of 6.48 ppb in Lower Granite reach and an arithmetic mean of 2.07 ppb. DDT was detected in only five samples, with a mean arithmetic concentration of 1.62 ppb.

Total DDT (DDD, DDE, and DDT) concentrations ranged from nondetect to 32.8 ppb with an average concentration of 8.23 ppb. The highest mean reach concentration for total DDT was 11.3 ppb for Lower Granite Lake. The average reach concentration of total DDT decreased steadily from Lower Granite Lake down to 5.7 ppb as recorded in Lake Sacajawea. The maximum and average total DDT concentrations in the lower Snake River sediments exceed the guidance levels set forth in the Puget Sound Dredged Disposal Analysis Guidance Manual: Data Quality Evaluation for Proposed Dredged Material Disposal Projects (PTI Environmental Services, 1989) or recommended screening concentration (6.9 ppb), but are lower than the bioaccumulation trigger concentration of 50 ppb as established in the Portland District Dredged Material Evaluation Framework (DMEF) (Corps, 1998). Concentration levels above the screening level prompt biological testing to ascertain health risks to aquatic organisms using the DMEF (Corps, 1998).

The pesticides aldrin, dieldrin, endrin, heptachlor, and lindane were all detected in five or fewer of the 1994 dredge material sediment evaluation samples. The concentrations range was as follows: aldrin ranged from nondetect to 3.5 ppb, dieldrin ranged from nondetect to 8 ppb, endrin ranged from nondetect to 9.4 ppb, heptachlor ranged from nondetect to 4.9 ppb, and lindane ranged from nondetect to 5.5 ppb. The maximum concentrations of aldrin, dieldrin, heptachlor, and lindane in the Snake River sediment are

lower than their screening level concentration of 10 ppb. No screening level has been established for endrin in the DMEF (Corps, 1998).

The greatest risk associated with DDT and other organophosphorus pesticides and herbicides is bioaccumulation. Bioaccumulation of DDT from consumption of fish tissue is possible because humans are the apex of the food chain. The highest concentrations of DDT are expected to be associated with the finer sediments deposited from stream run-off. Potential impacts from re-suspending sediments containing DDT and its daughter products are possible. Sediment samples would be collected and analyzed for DDT before construction of RSWs, BGSs, barge moorage cells, and the barge access area to determine the presence of DDT. Where DDT is found above the screening level or elutriate value, the specific material would be taken to an approved upland disposal site.

3.5.1.5 Effects of Mercury

The latest sampling for mercury took place about a mile below Silcott Island in the Lower Granite reservoir (CH2M HILL, 1999). Mercury was detected in two of four samples from that location at 230 μg/kg and 670 μg/kg. In 1997, mercury was measured about 1,700 μg/kg in this location (Anatek Labs, 1997). In 1985, (Crecelius and Gurtisen, 1985) sediment upstream of this location near the Port of Lewiston, Idaho, averaged only 30 μg/kg. In the Lower Granite reservoir, mercury seems to appear and reappear throughout the various sampling events. Although there was dispersion between samplings and the hydrologic cycles influenced sediment deposition, mercury still seems to be quite mobile in this portion of the lower Snake River.

Some organisms have the ability to convert the inorganic and organic forms of mercury to the highly toxic methyl mercury (Jensen and Jernolov, 1969). Methyl mercury and dimethyl mercury are concentrated many fold in fish because there is relatively no way for them to excrete methyl mercury (Train, 1979). The EPA Freshwater Criteria as of 1985 is 0.012 μg/L for 4 days with a 2.4 μg/L per 1 hour maximum average. Sediment samples referenced above contained well in excess of these levels and averaged eluate tests (0.1 μg/L) suggest a potential for a problem.

Excavation and sidecasting of sediments could liberate mercury from the sediments allowing it to elutriate into the water column. Data in FR/EIS, Appendix C, Water Quality on the amount of mercury in the sediment and the amount of mercury elutriated suggests 100 percent of any mercury found in sediments would be dissolved. However, mercury levels detected were near instrument lower detection limits.

Prior to the start of construction, sediment would be analyzed for mercury and elutriation. If mercury is found to be present, elutriated sediments and dissolved mercury in water would be monitored. If mercury levels exceed the Freshwater Criteria (EPA, 1985a) of 0.012 μg/L for 4 days with a 2.4 μg/L per 1 hour maximum average, work would be halted and consultation would be conducted with appropriate state and Federal agencies.

3.5.1.6 Effects from Zinc

Skidmore (1964) reviewed the toxicity of zinc to fish and reported that both an increase in temperature and a decrease of dissolved oxygen increased the toxicity of zinc. Toxic concentrations of zinc cause adverse changes in the morphology and physiology of fish. Acute concentrations induce cellular breakdown of the gills and clogs them with mucus (Train, 1979). Chronic concentrations of zinc cause general enfeeblement and widespread histological changes to many organs, but not to the gills (EPA, 1980). The level of toxicity is also dependant upon water hardness. Zinc is more toxic in soft

water than it is in hard water (EPA, 1980). Other metals, such as copper, can be synergistic with zinc depending on water hardness (Anderson and Weber, 1976).

In the Lower Granite reservoir, the average concentration of zinc in the sediments was 61,400 µg/kg (Anatek Labs, 1997). The eluate tests conducted in 1997 averaged 54,050 µg/L for the four lower Snake River reservoirs. The eluate test averaged 21.3 µg/L of zinc. Based on the equation developed for zinc by the EPA (EPA, 1985b), the acute criterion for the protection of aquatic life should not exceed certain limits because of the relative hardness of the water. Zinc is found in the sediments of the lower Snake River in abundant quantities.

Excavation and sidecasting of sediments could liberate zinc from the sediments allowing it to elutriate into the water column. Data in FR/EIS, Appendix C, Water Quality Appendix on the amount of zinc in the sediment and the amount of zinc elutriated suggest 31 percent, 29 percent, 40 percent, and 72 percent, of elutriated zinc at Lower Granite, Little Goose, Lower Monumental, and Ice Harbor, respectively, would be dissolved into the water column. Based on existing concentrations of zinc (Appendix C, Water Quality) and high degree of variability in the effects of zinc upon fish, the proposed action has the potential to surpass the acute condition criteria for rainbow trout (EPA, 1976) and pose a moderate or higher risk to fish.

Prior to the start of construction, sediment would be analyzed for zinc and elutriation and water would be analyzed for hardness. Elutriate would be analyzed to determine if an acute or chronic condition is created for specific species of fish that may be present during construction. If a chronic or acute condition is identified, additional bioassay analysis would be required.

3.5.1.7 Effects from Copper

In most cases, copper is not considered a potential contaminant. It is an essential element for the propagation of plants and is required for animals because it is an important constituent of insect blood chemistry (Train, 1979). Copper in excess of what is needed for health and vitality can be very detrimental to the primary producer level of the food chain. Ibragim and Patin (1975) demonstrated that copper concentration of 10 µg/L to 100 µg/L inhibited phytoplankton growth. Copper toxicity is very similar to zinc in relation to its interactions with water hardness and the temperature/alkalinity complex (EPA, 1985b).

Acute toxicity data are available for 41 genera (EPA, 1985b). At a water hardness of 50 mg/L as $CaCo_3$, the genera ranged in sensitivity to copper between 16.74 µg/L and 10,240 µg/L. The lowest acute toxicity concentration for a single test was 6.5 µg/L for exposure of the cladocera (*Daphnia magna*) in hard water. The values ranged 3.87 µg/L in an early life stage test with *Salvelinus fontinalis* to 60.36 µg/L in an early life stage test with *Esox lucius*. In the 1997 study (Anatek Labs, 1997), the average value for zinc in the eluate test was 21.3 µg/L.

No factual determinations have been made regarding the effects on resident genera and species in the lower Snake River. Information in the literature is sparse and no comparisons have been made at this time. Because copper sulfate is used frequently as a fungicide in this area, copper can be a contaminant based on possible deposition in areas potentially enriched with zinc and because of its potential for synergistic toxicity.

Excavation and sidecasting of sediments could liberate copper from the sediments, allowing it to elutriate into the water column. Data in FR/EIS, Appendix C, Water Quality on the amount of copper in the

sediment and the amount of copper elutriated suggest 13 percent, 13 percent, 19 percent, and 14 percent of elutriated copper at Lower Granite, Little Goose, Lower Monumental, and Ice Harbor, respectively, would be dissolved into the water column.

Prior to the start of construction, sediment would be analyzed for copper and elutriation and water would be analyzed for hardness. Elutriate would be analyzed to determine if an acute or chronic condition is created for specific species of fish that may be present during construction. If a chronic or acute condition is identified, additional bioassay analysis would be required.

3.5.1.8 Effects from Turbidity

Discharges of dredged and fill material associated with the proposed action would increase turbidity levels above background. The effects of the discharges and actions to minimize their impacts are presented in Section 3.4 above.

3.5.2 Fill Material

Contaminants could be introduced into the aquatic environment through the accidental discharge of wet concrete directly into the water, and through use of contaminated gravel to construct the barge moorage cells and barge access area.

To minimize the potential for introduction of contaminants, wet concrete to construct the pier nose extensions would be discharged into an area dewatered by a cofferdam/bulkhead. Pre-cast concrete discharged as fill material would be adequately dried prior to placement in the water. Gravel discharged into the constructed moorage cells and behind the sheet pile wall of the barge access area would be washed of any silts and soils prior to placement.

3.5.3 Actions to Minimize Impacts on the Aquatic Environment

Monitoring of ammonia concentrations would be conducted during construction to assess the accuracy of predicted impacts. If, during discharge activities, ammonia levels at monitoring sites exceed state and Federal limits, discharge activities would temporarily cease until ammonia levels at monitoring sites return to levels within state and Federal limits.

Prior to the start of construction, sediment would be analyzed for mercury and elutriation. If mercury were found to be present, elutriated sediments and dissolved mercury in water would be monitored. If mercury levels exceed the Freshwater Criteria (EPA, 1985b) of 0.012 μg/L for 4 days with a 2.4 μg/L per 1 hour maximum average, work would be halted and consultation would be conducted with appropriate state and Federal agencies.

Prior to the start of construction, sediment would be analyzed for zinc and elutriation and water would also be analyzed for hardness. Elutriate would be analyzed to determine if an acute or chronic condition is created for specific species of fish that may be present during construction. If a chronic or acute condition were identified, additional bioassay analysis would be conducted.

Prior to the start of construction, sediment would be analyzed for copper and elutriation and water would be analyzed for hardness. Elutriate would be analyzed to determine if an acute or chronic condition is created for specific species of fish that may be present during construction. If a chronic or acute condition were identified, additional bioassay analysis would be conducted.

Wet concrete used to construct pier nose extensions would be discharged into an area dewatered by a cofferdam/bulkhead to minimize the potential for introduction of contaminants into the water.

Pre-cast concrete discharged as fill material would be adequately dried prior to placement in the water.

Gravel discharged into the constructed moorage cells and behind the sheet pile wall of the barge access area would be washed of any silts and soils prior to placement to minimize the potential introduction of contaminants.

3.6 Aquatic Ecosystem and Organism Determinations

3.6.1 Plankton Effect

3.6.1.1 Phytoplankton and Zooplankton

Most of the phytoplankton and zooplankton species prevalent in the spring that supply the bulk of the nutrition to the ecosystem would be in the resting stage and would not receive dramatic harm from these actions.

3.6.2 Benthos Effects

A large amount of material has been discussed about the effects to the benthic invertebrate community. There would be an inevitable loss to the benthic community by most of these actions. In the large scheme of the reservoir ecosystem, the loss of the few organisms is insignificant when measured against the entire biomass of these animals in the entire system. Implementation of measures identified to minimize impacts would also lessen the effects upon the benthic community.

3.6.3 Nekton Effects

3.6.3.1 Disposal Effects on Juvenile Pacific Lamprey

Juvenile Pacific lamprey (*Lampetra tridentata*) use the areas near the dams from early spring to mid-summer primarily as a migratory corridor. Although the substrate in the forebays are composed of fine materials, a preferred rearing substrate, juvenile lamprey typically rear in shallow, clear water streams downstream from spawning areas (Close et al., 1995, Corps, 1999 [see Appendix M]). Work conducted in the forebays during the winter in-water work window should have no effect on the rearing or outmigration life phases. Short- and long-term effects of the discharge of dredged or fill material in the forebays of the dams would, therefore, be negligible. The permanent sidecasting of dredge material in the forebays of the dams would have no negative effects despite juveniles migrating near the bottom of the reservoirs (Close et al., 1995).

Although juvenile Pacific lamprey use the areas near the dams primarily as a migratory corridor, they do burrow into cobble and boulder substrates to overwinter (Pletcher, 1963). No lamprey have been documented in the winter in the tailrace. Short- and long-term effects of discharging dredged or fill material in the tailraces of the dams would be negligible. The permanent sidecasting of dredged material in the tailraces of the dams would also have no negative effects.

3.6.3.2 Disposal Effects on Adult Pacific Lamprey

Work conducted during the winter in-water work window of December 15 through March 1 would have no effect on the immigration of adult lamprey. Adult Pacific lamprey immigrate from mid-spring to late

summer and are not expected to experience any negative effects from the discharge of dredged or fill material in the forebay or tailrace. The construction process for the extension of pier noses and addition and modification of deflections may affect overwintering adult lamprey; however, the actual discharge of dredged and fill material should have no impact. Short- and long-term effects of discharging dredged or fill material in the forebays and tailraces of the dams would be negligible. The permanent sidecasting of dredged material in the forebays of the dams would have no negative effects despite the presumable adult Pacific lamprey migration to the bottom of the sea.

3.6.4 Aquatic Food Web Effects

The winter months have a very different food web when compared to the spring, summer, and fall months. The bioenergetics of the system slow down parallel to the decrease in temperature because most freshwater aquatic organisms are poikilothermic. Some organisms feed very little in the winter and live off stored fat reserves. Aquatic insects do feed and rely on detritus for food sources. The disturbances caused by the localized discharges would interrupt food supplies to the localized benthic organisms but this would be minor and short term. Suspension would also uncover some additional food supplies buried in the interstitial sediments and waters.

Because most of the spring and summer dominant species of plankton are in the resting stage, little effect to the food web is expected. The winter phytoplankton species are relatively unstudied. Only minor changes are expected because the discharges would be small and infrequent. There would be virtually no effect to the food web as it pertains to threatened and endangered species.

3.6.5 Special Aquatic Site Effects

3.6.5.1 Sanctuaries and Refuges

Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would not occur in or close to a sanctuary or refuge complex. Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would have no effect on this special aquatic site.

3.6.5.2 Wetlands

Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would not occur in or close to a wetland. Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would have no effect on this special aquatic site.

3.6.5.3 Mud Flats

Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would not occur in or close to a mudflat. Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would have no effect on this special aquatic site. For purposes of this description, areas in the forebay and in the backwater areas within 4 miles of the dams are not considered mudflats. This is because the deposition is composed of 90 percent sediments and not of soils characteristic of wetlands or shallow flats that would support vegetation or provide habitat for waterfowl.

3.6.5.4 Vegetated Shallows

Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would not occur in or close to vegetated shallows. Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would have no effect on vegetated shallows.

3.6.5.5 Riffle and Pool Complexes

Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would not occur in close to a riffle and pool complex. Discharges of dredged and fill material associated with the recommended plan (preferred alternative) would have no effect on this special aquatic site.

3.6.6 Threatened and Endangered Species

In 1995, the Corps, U.S. Bureau of Reclamation (BOR), and Bonneville Power Administration (BPA) (collectively termed "action agencies") consulted under Section 7 of the Endangered Species Act (ESA) of 1973 as amended on the operation of the Federal Columbia River Power System (FCRPS) with the NMFS and the U.S. Fish and Wildlife Service (USFWS). This particular consultation resulted in three separate biological opinions being issued by NMFS and USFWS covering the anadromous and resident fish species that were listed at the time. The NMFS then issued a supplemental biological opinion in 1998 that addressed the additional listing, since 1995, of upper Columbia steelhead. In 1999, NMFS listed six additional populations of anadromous fish as either threatened or endangered and USFWS listed one additional resident fish species pursuant to the ESA.

In 1999, the action agencies prepared the Multi-species Biological Assessment (BA) of the Federal Columbia River Power System, December 21, 1999 and reinitiated consultation on the FCRPS. The BA evaluated the potential effects of the operation of the FCRPS on the continued existence of all species either listed, proposed, or designated as candidates for listing under the ESA that are potentially affected by these actions. The BA also described ongoing and potential future actions being considered within the system, including the FR/EIS.

Bull trout were addressed in a separate BA also prepared by the action agencies and submitted to the USFWS in December 1999 for reinitiation of consultation.

In response to the action agencies' BAs, the USFWS issued their Biological Opinion, Effects to Listed Species from Operations of the Federal Columbia River Power System, December 20, 2000; and NMFS issued their Biological Opinion, Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin, December 21, 2000.

In their December 21, 2000, Biological Opinion, NMFS concluded the impacts of the FCRPS jeopardize the continued existence of listed Snake River salmon and included a reasonable and prudent alternative the agency believes would avoid jeopardy.

In their December 20, 2000 Biological Opinion, USFWS concurred with the action agencies' determination that the proposed action may affect, but is not likely to adversely affect, the threatened or endangered species or species proposed for listing as threatened or endangered (see Table 3-9).

Table 3-9. Endangered Species Act Listings

Common Name	Scientific Name	Listing
	Mammals	
Grizzly bear	*Ursus arctos horribilis*	Endangered
Gray wolf	*Canis lupus*	Endangered
Woodland caribou	*Rangifer torandus caribou*	Endangered
Canada lynx	*Lynx canadensis*	Threatened
Northern Idaho ground squirrel	*Spermophilus brunneus brunneus*	Threatened
	Plants	
Macfarlane's four o'clock	*Mirabilis macfarlenei*	Threatened
Water howellia	*Howellia aquatilis*	Threatened
Ute's ladies tresses	*Spiranthes diluvialis*	Threatened
Spalding's silene	*Silene spauldinii*	Proposed

Source: USFWS, 2000

The USFWS also indicated that the effects of FCRPS operations on the bald eagle were documented in previous BAs and consultations with the USFWS and that a biological opinion regarding effects on the bald eagle was issued on March 1, 1995. The USFWS further explained that, because they were not aware of any changes in FCRPS operations that would warrant reinitiation of consultation, effects of operations on the bald eagle were not addressed in their December 20, 2000, Biological Opinion.

The December 20, 2000, Biological Opinion also analyzed the effects of the FCRPS on the bull trout in areas downstream of Hells Canyon Dam.

The Corps selected the recommended plan (preferred alternative) for the FR/EIS consistent with the contents of the above referenced biological opinions.

3.6.7 Aquatic Life Forms

3.6.7.1 Anadromous Fish

Most Snake River Basin juvenile and adult anadromous salmonids use the lower Snake River as a migratory corridor. The salmonids swim primarily in the upper water column from early spring to late fall. Exceptions to this include juvenile fall chinook and both juvenile and adult steelhead. Individuals of these species are present in the reservoir environment throughout the year. Of these, juveniles of both species are most likely to be present in low densities along sandy, shallow water shorelines and adults are typically not observed during the winter.

The discharge of dredged and fill material in the forebays would occur during the winter in-water work window. No anticipated short- or long-term effects to any salmonids are expected because anadromous salmonid densities in this area are extremely low at this time of year and fish do not typically occur at the depths of the proposed discharge. In addition, no short- or long-term effects of sidecasting the material are expected for fish migrating through the area because most salmonids are found in the upper water column.

The discharge of dredged or fill material in the tailraces would also occur during the winter in-water work window. Again, anadromous salmonid densities in this area are extremely low at this time of year. Although salmonids may be present in some of the shallower tailrace areas during the winter (e.g., the barge slip area), they typically prefer areas of sand substrate rather than the probable substrate of silt at that location. In addition, migrating fish are more likely to avoid backwater areas during the spring outmigration. Therefore, no short- or long-term effects to anadromous salmonids are anticipated from the discharge of dredged or fill materials. In addition, no short- or long-term effects of sidecasting the material are expected during the outmigration or immigration because most salmonids typically avoid using the backwater areas.

3.6.7.2 Resident Fish

Fish species in the reservoirs of the lower Snake River and McNary Dams include a mixture of native riverine and introduced species that typically are associated with lake-like conditions (Bennett et al., 1983; Bennett and Shrier, 1986; Hjort et al., 1981; Mullan et al., 1986). Introduced species are more common in the forebay zone and backwater areas while native species are more common in the flowing water regions found in the tailrace. Although adults will use various habitats, lake-dwelling species are generally more abundant in shallow, slower velocity backwater areas, and native riverine species occur more abundantly in areas with flowing water (Bennett et al., 1983).

In the forebay areas, very few fish are known to inhabit the reservoir floor near the proposed discharge locations. Most resident species reside in the photic zone and not in the deep-water environment of the forebay. Scavenger fish, including the native white sturgeon and various introduced species of catfish, may be present in these areas in very low densities throughout the year. Discharge of dredged and fill material in the forebays would have negligible effects on resident fish. Sidecasting of material may actually serve as a short-term benefit to bottom-dwelling species by exposing or re-distributing invertebrates that serve as a food source. No long-term benefits would be expected.

In the tailraces of the dams, the resident fish of most concern are the native and introduced predatory fish, white sturgeon, and bull trout. These species are of concern because enhancement of piscivorous fish habitat is undesirable, while enhancing habitat for sturgeon and bull trout is desirable. Other species, including suckers, peamouth, carp, etc., while important to the food web and overall health of the ecosystem, would be minimally impacted.

Backwaters and embayments generally provide low water velocity, slightly warmer water, finer substrate, and submerged and emergent vegetation. Backwaters and embayments are used by predatory fish such as bass, black crappie, white crappie, bluegill, pumpkinseed, and yellow perch for spawning and rearing (Bennett et al., 1983; Bennett and Shrier, 1986; Hjort et al., 1981; Bennett et al., 1991; Zimmerman and Rasmussen, 1981). At Lower Granite Dam, the work in the barge cells is expected to have the most impact to resident predatory fish. The disposal of dredged material in this area may serve as a short-term benefit to these fish by re-distributing and exposing invertebrates commonly preyed upon by these species. In addition, the sidecast material may provide increased long-term shallow water habitat in the embayment, enhancing spawning and rearing habitat for predatory fish.

White sturgeon probably use the backwater area as a foraging and resting area. The disposal of dredged material in this area may serve as a short-term benefit to these fish by redistributing and exposing invertebrates commonly preyed upon by these species. No short- or long-term impacts are expected to occur with the discharge of fill material at this location.

Bull trout, listed as threatened under the ESA, are found primarily in colder streams, although individual fish are found in larger river systems throughout the Columbia River Basin (Fraley and Shepard, 1989; Rieman and McIntyre, 1993, 1995; Buchanan and Gregory, 1997). The density of bull trout in the backwater embayment at Lower Granite Dam is not known; however, any occurrence of these fish in the backwater during any time of the year is unexpected. No short- or long-term effects to bull trout from discharge of fill or dredged material are anticipated.

3.6.7.3 Other Aquatic Organisms

The northwestern species of crayfish (*Pacifasticus lenensculis)* inhabits most of the lower Snake River drainage. This decapod is important to the ecosystem because of its scavenger life style and its importance as a food source for bass and other sport fish. This animal prefers to feed on dead and decaying fish and other aquatic organisms. This animal is important in keeping the bottom cleaned of rotting carcasses.

Small impacts to this species could occur. During excavation and discharge, some animals could be crushed or merely displaced, requiring them to seek shelter elsewhere. In addition, placement of the fill could crush some animals. The amount of fill and timing of the event would preclude any but a few possible casualties. No serious disruptions should occur except for the moorage excavations that are discussed in other areas of this document.

3.6.8 Land-based Life Forms

Extensive information on the occurrence of mammals, birds, amphibians, and reptiles is contained in Section 4.6 of the FR/EIS. Discussion of the effects of the recommended plan (preferred alternative) upon wildlife are presented in Section 5.5 of the FR/EIS and in Appendix M, Fish and Wildlife Coordination Act Report.

The discharge of dredged and fill material would not result in the loss of or change in the nesting and breeding areas, escape cover, travel corridors, or preferred food sources for mammals, birds, amphibians, or reptiles. Turbidity resulting from the discharge of dredged and fill material is not expected to affect wildlife species that rely upon sight to feed.

3.6.9 Actions Taken to Minimize Impacts

All in-water work would be conducted during the standard in-water work window of December 15 through March 1 to minimize impacts upon Federally listed anadromous species, unless coordinated with resource agencies.

3.7 Proposed Disposal Site Determinations

3.7.1 Mixing Zone Determination

Ecology will determine mixing zones. Historically, the mixing zones were established at 300 meters downstream. The practical mixing zone for work upstream of the powerhouse in the winter is the area between the construction site and the turbines. Monitoring at the outfall of the operating units has proven to be the most useful area even if it is only 200 meters downstream. This is because it reflects the extent of the true point of release into the downstream environment. The turbines also have flow-mixing effects on the affected waters that minimize the disturbances or chemical impacts.

3.7.2 Determination of Compliance with Applicable Water Quality Standards and Regulations

3.7.2.1 Section 401 Certification

Section 401 of the Clean Water Act requires applicants requesting a Federal license or permit to conduct activities that may result in a discharge in waters of the United States to provide to the licensing or remitting agency a certification from the state that says any such discharge complies with the applicable water quality standards. As individual actions are ready for implementation, they would be evaluated and Section 401 Certification obtained, if necessary, prior to discharges in waters of the United States.

3.7.3 Potential Effects on Human Use Characteristics

3.7.3.1 Municipal and Private Water Supply

There are no municipal or private water supply intakes in the Snake River near the four dams. Eight active large-scale pumping plants located upstream of Ice Harbor Dam supply irrigation water for circle irrigation systems, vineyards, orchards, pulp trees, and numerous row crops (FR/EIS, Appendix D, Natural River Drawdown Engineering). Water intakes in Lewiston, Idaho, and just south of Lewiston, provide water for two commercial industrial operations. In addition, the cities of Clarkston, Washington, and Lewiston, Idaho, each operate a water intake to supply irrigation water to golf courses.

The eight irrigation pumping plants are located upstream of the work site at Ice Harbor Dam and approximately 16 miles downstream of the work site at Lower Monumental Dam. Water intakes at or near Lewiston, Idaho, and Clarkston, Washington, are located upstream of the work site at Lower Granite Dam. No impacts on water quality at the sites of the intakes are expected because of the remoteness of these intakes from the work sites.

3.7.3.2 Recreational and Commercial Fisheries

No commercial fishing activities are conducted in the lower Snake River; therefore, the discharges associated with the recommended plan (preferred alternative) would not impact commercial fisheries.

Recreational fishing for anadromous and resident fish occurs throughout the Snake River. Among resident species, the reservoirs are host to 18 native species and 17 introduced fish. A list of resident fish species compiled from several sources with common and scientific names is shown in Table 3-3 of Appendix B, Resident Fish to the FR/EIS. Estimates of sport fishing harvest of selected fish in the lower Snake River reservoirs are presented in Table 3-7 of Appendix B to the FR/EIS.

White and black crappie, smallmouth bass, and channel catfish represent introduced species that are highly sought by sport anglers throughout the reservoir system (Normandeau Associates et al., 1998). The native northern pikeminnow is the focus of population reduction efforts via a sport reward program that pays bounties for removal of large individuals (Friesen and Ward, 1997). Sport anglers pursue northern pikeminnow largely in Lower Granite Lake, mostly due to the bounty paid by the sport reward program (Freisen and Ward, 1997). Black crappie and white crappie are two of the more important sport fish in backwater habitats in the lower Snake River reservoirs (Knox, 1982; Normandeau Associates et al., 1998). They are highly habitat-specific in the reservoirs and are chiefly limited to embayment areas off the main channel. Smallmouth bass is one of the more abundant and widely distributed species in the lower Snake River reservoirs (Bennett et al., 1997) and an important sport fish (Normandeau Associates et al., 1998). More extensive information on these and other resident species is available in Appendix B, Resident Fish of the FR/EIS.

Among anadromous species, the Snake River steelhead is the only species for which there currently is an annual recreational harvest season in the Snake River. On May 1, 2001, a portion of the Snake River also opened for a limited harvest season of hatchery spring chinook (Washington Department of Fish and Wildlife, 2001).

The area of the forebay at each of the four dams is not open to boat access; therefore, direct impacts of construction upon recreational fishing in the forebay is expected to be negligible.

The sites of dredged and fill activity for barge moorage cells and the barge access area at Lower Granite is accessible to boaters. It is anticipated that the area would be restricted to boat access during construction of these facilities. This would result in a temporary minor impact upon recreational fishing activity due to limited access.

As indicated in Section 3.4.3.3 above, typically in freshwater systems, primary productivity decreases during the winter months due in part to decreases in photoperiod and temperature. As a result, zooplankton decreases, causing sight feeders to alter feeding habits to more benthic-oriented prey items (e.g., snails, worms, etc.). In addition, the activity and metabolism of poikilothermic organisms tends to slow with decreases in temperature, resulting in lower feeding rates. No negative impacts are expected to affect feeding habits in the areas of activity because the disposal of fill and dredged material is to occur in the in-water work window. In addition, the dredging and disposal process may benefit sight feeders by exposing and redistributing benthic prey items from below the substrate to where fish may have access to them. Because steelhead would not be adversely affected and this activity may be beneficial to some species, no more than negligible impacts to recreational fishing are anticipated.

See Sections 3.6.7.1 and 3.6.7.2 above for further information on anadromous and resident fish.

3.7.3.3 Water-related Recreation

The sites of the discharges of dredged and fill material are restricted from public access; therefore, no effects to water-related recreation would result.

3.7.3.4 Aesthetics

Aesthetic impacts may result from turbidity generated by the discharge of dredged material. Based on findings related to turbidity, impacts upon aesthetics are anticipated to be localized, short-term, and minor. Actions identified in Section 3.4.4 to minimize impacts related to turbidity would also minimize potential impacts of turbidity upon aesthetics.

3.7.3.5 Parks, National Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

No National Historical Monuments, National Seashores, Wilderness Areas, or Research Sites occur in the vicinity of the four Snake River dams. Various park facilities (campgrounds, day-use, and boat launches) are situated near each of the dams. The discharges of dredged and fill material would not reduce or eliminate the uses for which the parks/facilities are set aside and managed.

3.7.3.6 Actions to Minimize Impacts

The general construction area of the reservoir for the barge moorage cells and barge access area at Lower Granite would be signed to restrict access to boaters for public safety. Access restrictions would be removed immediately upon completion of construction to allow resumption of recreational fishing activity.

Actions identified in Section 3.4.4 to minimize impacts related to turbidity would also minimize potential impacts of turbidity related to mixing zone and upon aesthetics.

3.8 Determination of Cumulative Effects on the Aquatic Ecosystem

EPA's Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230 December 24, 1980) defines cumulative effects as "the changes in an aquatic ecosystem that are attributable to the collective effect of a number of individual discharges of dredged or fill material. Although the impact of a particular discharge may constitute a minor change in itself, the cumulative effect of numerous such piecemeal changes can result in a major impairment of the water resources and interfere with the productivity and water quality of existing aquatic ecosystems" (40 CFR Part 230.11).

The following analysis identifies the array of discharges proposed in the recommended plan (preferred alternative) and potential future discharges that are likely to occur in the foreseeable future. The analysis attempts to predict, to the extent reasonable and practical, the cumulative effects attributable to those discharges. The goal of the analysis is to assess whether the cumulative effects may result in major impairment of the water resources and interfere with the productivity and water quality of the lower Snake River.

3.8.1 Summary of Discharges Associated with the Proposed Action

Table 3-10 provides a summary of the actions proposed under the recommended plan (preferred alternative) and indicates by the placement of an "x" which of those actions would involve the discharge of dredged and/or fill material. A more complete description and summary, including estimated dimensions and volumes, may be found in Section 2.7.2 above.

3.8.2 Summary of Potential Corps Future Discharges

Table 3-11 identifies a range of potential activities that, based on past history and needs, could inherently involve discharges of dredged material and are likely to occur in the future. These include the general categories of maintenance dredging for navigation, maintenance dredging to keep port basins and boat basins open and accessible, maintenance dredging at public recreation areas, and maintenance dredging to maintain irrigation intakes. These projected dredging activities are currently under evaluation in the Corps' DMMS, as described in Section 2.3.2 above. Alternatives under investigation in the DMMS for accomplishing these activities include the following: 1) continue the present practice of maintaining the navigation channels, dredging of access channels to port and moorages (boat basins), public recreation areas, irrigation intakes for wildlife Habitat Management Units (HMUs), and flow conveyance capacity of the Lower Granite Lake and disposing of the material in water; 2) continue the dredging, but formalize the disposal method to create shallow water fishery habitat with the selective disposal of material; 3) continue the dredging practices but with upland disposal of dredged material; and 4) continue the dredging, but dispose of dredged material with emphasis upon beneficial uses such as creating aquatic and wildlife habitat, replenishing beaches, or filling upland commercial sites.

Table 3-10. Summary of Proposed Dredged and Fill Material Discharges

Actions	Lower Granite		Little Goose		Lower Monumental		Ice Harbor	
	Dredged Material Discharges	Fill Material Discharges	Dredged Material Discharges	Fill Material Discharges	Dredged Material Discharges	Fill Material Discharges	Dredged Material Discharges	Fill Material Discharges
RSW	x	x	x	x	x	x	x	x
BGS	x	x			x	x	x	x
SBC	x	x	x	x	x	x		
Pier Nose Extension		x		x		x		
Add End Bay Deflectors				x		x		
Modify Existing Deflectors		x		x		x		
Bank Stabilization		x						
Bypass Outfall Support Column		x						
Barge Moorage Cells	x	x						
Barge Access Area		x						

Table 3-11. Summary of Potential Corps Future Discharges

Activity	Lower Granite		Little Goose		Lower Monumental		Ice Harbor	
	Dredged Material Discharges	Fill Material Discharges	Dredged Material Discharges	Fill Material Discharges	Dredged Material Discharges	Fill Material Discharges	Dredged Material Discharges	Fill Material Discharges
Navigation Dredging	x		x		x		x	
Port Dredging	x		x		x		x	
Boat Basin Dredging	x		x		x		x	
Public Recreation Area Dredging	x		x		x		x	
Irrigation Intake Dredging	x		x		x		x	
Stilling Basin Repair					x	x		

Source: Corps, 2001

3.8.2.1 Potential Future Public and Private Port Maintenance

Table 3-12 represents an inventory of public and private ports along the lower Snake River. No ports are located within Lake West (Lower Monumental Reservoir). No projections are made regarding which of these may require future maintenance dredging. It is reasonable to assume during the next 20 years, maintenance dredging would be required on some or all of the ports.

3.8.2.2 Maintenance Dredging for Boat Basin Access and Public Recreation Areas

Table 3-13 identifies boat basins and recreation areas within the lower Snake River that may require future maintenance dredging. Additional sites could be identified for future maintenance dredging. Not all of the sites identified may require maintenance dredging. RM locations identified in the table are approximate.

3.8.2.3 Maintenance Dredging for Irrigation Intakes

The Corps manages 10 HMUs at which irrigation intakes are operated. The Corps also operates irrigation intakes at various recreation areas. The potential exists for discharges of dredged material to occur in association with maintenance of these intakes. Maintenance generally occurs on an in-frequent basis.

Table 3-12. Maintenance Dredging Locations for Potential Future Public and Private Port

Lower Granite Lake	Lake Bryan	Lake Sacajawea
Tidewater Terminal Company	Pomeroy Grain Growers Dock	Walla Walla Grain Growers, Shefler Dock
Port of Whitman County	Columbia Grain	Louis Dreyfus Windust Station Dock
Potlatch Corporation	Central Ferry Elevator	Columbia County Grain Growers
Mountain Fir Lumber Company, Wilma Dock	Central Ferry Terminal	Lyons Ferry Dock
Stegner Grain Terminal Dock	McGregor Terminal	
Port of Whitman County Docks	Almota Elevator Company Dock	
Port of Clarkston Dock	Port of Almota Dock, S&R Grain	
Clarkston Grain Terminal Dock		
Mountain Fir Lumber Company		
Port of Lewiston Container Terminal		
Continental Grain Company, Lewiston Dock		
Lewis-Clark Terminal Association Dock		

Source: BPA et al., 1995 (Appendix H, Table 8-1)

Table 3-13. Maintenance Dredging Locations for Potential Future Boat Basin and Recreation Area

Lower Granite Lake		Lake Bryan		Lake West		Lake Sacajawea	
Basin	Snake River Mile	Basin	Snake River Mile	Basin	Snake River Mile	Basin	Snake River Mile
Blyton Landing	119.0	Boyer Park and Marina	105.5	Ayer Boat Basin	52.0	Big Flat Recreation Area	16.0
Chief Looking Glass	144.0	Central Ferry State Park	83.5	Devils Bench	42.0	Charbonneau Recreation Area	11.5
Chief Timothy State Park	131.0	Illia Landing	104.0	Lower Monumental Dam	41.5	Fishhook Park	18.0
Greenbelt Ramp	140	Little Goose Dam	70.5	Lyons Ferry Marina	58.5	Ice Harbor Dam Recreation Area	9.0
Hells Canyon Resort	137.5	Little Goose Landing	71.0	Lyons Ferry State Park	59.0	Levey Park	13.0
Hells Gate State Park	142.5	Willow Landing	89.0	Riparia Recreation Area	67.0		
Nisqually John Landing	120.5			Texas Rapids Recreation Area	67.0	Matthews Recreation Area	41.5
Offield Landing	108					Windust Park	39.0
Southway Ramp	140.9						
Swallows Park	142.0						
Wawawai Landing	111.0						
Swallows Swim Beach	141.7						

Source: Corps, 2001

3.8.2.4 Other Potential Future Discharges

Dam Breaching

The NMFS 2000 Biological Opinion directs the Corps to develop plans for potential future recommended actions relating to dam breaching (Actions 147 and 148 of the Biological Opinion). Discharges of dredged and fill material would occur in association with implementation of a drawdown alternative. Further information on dam breaching may be found in Appendix D, Natural River Drawdown Engineering to the FR/EIS.

Irrigation Intakes for Agriculture

There are eight active large-scale pumping plants in the 21-kilometer (13-mile) reach of the Snake River upstream of Ice Harbor Dam (Appendix D, Natural River Drawdown Engineering) that supply irrigation

water for circle irrigation systems, vineyards, orchards, pulp trees, and numerous row crops. The potential exists for discharges of dredged material to occur in association with maintenance of these intakes.

Highway and Railroad Bridge Repair and Replacement

Nine highway or railroad bridges cross the reservoirs of the lower Snake River (Appendix D, Natural River Drawdown Engineering). The potential exists for discharges of dredged and fill material to occur in association with repair or replacement of these structures.

Railroad and Highway Embankment Maintenance

Various sections of railroad and highway embankments located adjacent to the reservoirs ordinary high water mark are armored with riprap. Maintenance of these sections could occur through the addition of riprap. No estimates of quantities or frequency of discharge are available.

3.8.3 Summary of Predicted Cumulative Effects upon the Aquatic Ecosystem

3.8.3.1 Cumulative Substrate Effects

The discharges of dredged and fill material associated with the proposed action would permanently eliminate portions of the substrate. The overall area eliminated would be miniscule in comparison to the overall area of substrate of the lower Snake River.

Potential future discharges of dredged material associated with the Corps' maintenance dredging could have long term substrate impacts under the DMMP/EIS Alternative 1, in which standard in-water dredged material disposal would occur. For Alternative 2, beneficial substrate effects would occur through selective dredged material disposal for shallow water fish habitat. Under the recommended plan (preferred alternative), upland disposal of dredged material and substrate effects from the discharge of dredged material would not occur. Beneficial substrate effects would occur under Alternative 4 through beneficial use of the dredged material. The Draft DMMP/EIS (January 2001) identified Alternative 4 as the Corps' recommended plan (preferred alternative). Because substrate effects from the proposed action would be minor and because potential future discharges of dredged material associated with the Corps' maintenance dredging incorporates mitigation features that would restore valuable aquatic habitat to the system through beneficial use of dredged material, the cumulative effects of the Corps' proposed and future actions should not pose an irreversible loss of valuable aquatic resources.

Other discharges associated with potential future maintenance of irrigation intakes for agriculture, highway and railroad embankment repairs, and bridge repair and/or replacement could have minor to major substrate effects. Prediction of effects from these activities upon the substrate is extremely difficult. Estimation of the degree and duration of future effects is virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential effects upon the substrate would be imposed, as has been done for the Corps' proposed action. If actions to minimize these potential effects were implemented, the cumulative effect of the Corps' proposed and future discharges as well as irrigation intakes and rail and highway embankment and bridges should not result in major impairment of the water resources and interfere with the productivity and water quality of the existing aquatic ecosystem of the Snake River. Absent implementation of any actions to minimize impacts resulting from potential future discharges, significant cumulative substrate effects would likely occur.

3.8.3.2 Cumulative Water Salinity, Circulation, and Fluctuation Effects

Predicted effects of the proposed action upon water salinity, circulation, and fluctuation ranged from "no change" to "minor" to "localized and of short-duration," with incorporation of various actions to minimize potential effects. Prediction of effects upon water salinity, circulation, and fluctuation resulting from potential future discharges associated with the Corps' maintenance dredging for navigation, maintenance dredging to keep port basins and boat basins open and accessible, maintenance dredging at public recreation areas, and dredging to maintain irrigation intakes, is extremely difficult. Estimation of the degree and duration of future effects is virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts upon water salinity would be imposed, as has been done for the proposed action. If actions to minimize were implemented, the cumulative effect of proposed and future discharges should not pose an irreversible loss of valuable aquatic resources. Absent implementation of any actions to minimize impacts resulting from the proposed action and the Corps' potential future discharges, significant cumulative substrate effects would likely occur.

Other discharges associated with potential future maintenance of irrigation intakes for agriculture, highway and railroad embankment repairs, and bridge repair and/or replacement could have minor to major substrate effects. Prediction of effects from these activities upon the substrate is extremely difficult. Estimation of the degree and duration of future effects for these actions is also virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts upon the substrate effects would be imposed, as has been done for the Corps' proposed action. If actions to minimize these potential effects were implemented, the cumulative effect of the Corps' proposed and future discharges as well as repairs to irrigation intakes and rail and highway embankment and bridges should not result in major impairment of the water resources and interfere with the productivity and water quality of the existing aquatic ecosystem of the Snake River. Absent implementation of actions to minimize impacts resulting from potential future discharges, significant cumulative substrate effects would likely occur.

3.8.3.3 Cumulative Current Patterns and Circulation Effects

Determination of the effects of the Corps' proposed discharges of dredged and fill material upon current patterns and circulation ranged from "no effect," to "minor," "negligible," "insignificant," and "localized short-term." Additionally, alteration of flows due to SBCs was predicted to be beneficial to attracting anadromous fish.

Prediction of effects upon current patterns and circulation resulting from the Corps' potential future discharges associated with maintenance dredging for navigation, maintenance dredging to keep port basins and boat basins open and accessible, maintenance dredging at public recreation areas, and maintenance dredging to irrigation intakes, is extremely difficult. Estimation of the degree and duration of future effects is virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts upon current patterns and circulation would be imposed, as has been done for the proposed action. If actions to minimize effects were implemented, the cumulative effect of proposed and future discharges should not pose an irreversible loss of valuable aquatic resources, based on the anticipated predominance of predicted minor, negligible, insignificant, and no effects of the various actions. Absent implementation of any actions to minimize impacts resulting from potential future Corps' discharges, significant cumulative effects upon current patterns and circulation could occur. Other discharges associated with potential future

maintenance of irrigation intakes for agriculture, highway and railroad embankment repairs, and bridge repair and/or replacement could have minor to major impacts on current patterns and circulation.

Prediction of effects from these activities upon the substrate is extremely difficult. Estimation of the degree and duration of future effects for these actions is also virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts upon the substrate would be imposed, as has been done for the Corps' proposed action. If actions to minimize these potential effects were implemented, the cumulative effect of the Corps' proposed and future discharges as well as repairs to irrigation intakes and rail and highway embankment and bridges should not result in major impairment of the water resources and interfere with the productivity and water quality of the existing aquatic ecosystem of the Snake River. Absent implementation of actions to minimize impacts resulting from non-Corps potential future discharges, significant cumulative substrate effects would likely result.

3.8.3.4 Cumulative Suspended Particulates and Turbidity Effects

Determination of the effects of the discharges of dredged and fill material upon suspended particulates and turbidity ranged from "no effect," to "minor," "negligible," "insignificant," and "localized short-term." Additionally, potential adverse chemical and physical effects from ammonia in the Lower Granite pool were judged to be extremely high because the elutriate ammonia average (3.6 mg/L @ 8.5 pH) could exceed the early life stage criterion three-fold and could also exceed both acute criterions (2.14 mg/L and 3.20 mg/L). Potential impacts upon ammonia in the Little Goose, Lower Monumental, and Ice Harbor pools were judged to be moderate because the elutriate ammonia average could exceed the chronic early life stage criterion. Actions to minimize the risk in the form of monitoring would be implemented.

Prediction of effects from suspended particulates and turbidity resulting from potential future Corps' discharges associated with maintenance dredging for navigation, maintenance dredging to keep port basins and boat basins open and accessible, maintenance dredging at public recreation areas, and maintenance dredging irrigation intakes is extremely difficult. Estimation of the degree and duration of future effects is virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts upon suspended particulates and turbidity would be imposed, as has been done for the proposed action. If actions to minimize effects were implemented, the cumulative effect of proposed and future Corps' discharges should not pose an irreversible loss of valuable aquatic resources. Absent implementation of any actions to minimize impacts resulting from potential future Corps' discharges, significant cumulative effects from suspended particulates and turbidity could occur.

Other discharges associated with potential future maintenance of irrigation intakes for agriculture, highway and railroad embankment repairs, and bridge repair and/or replacement could have minor to major impacts on suspended particulates and turbidity. Prediction of effects from these activities upon the substrate is extremely difficult. Estimation of the degree and duration of future effects for these actions is also virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential effects upon the substrate would be imposed, as has been done for the Corps' proposed action. If actions to minimize these potential effects were implemented, the cumulative effect of the Corps' proposed and future discharges as well as repairs to irrigation intakes and rail and highway embankment and bridges should not result in major impairment of the water resources and interfere with the productivity and water quality of the existing aquatic ecosystem

of the Snake River. Absent implementation of actions to minimize impacts resulting from non-Corps potential future discharges, significant cumulative effects would likely result.

3.8.3.5 Cumulative Contaminant Effects

Determination of effects of the Corp's proposed discharge of dredged material revealed the potential for adverse effects from contaminants. Potential effects from ammonia in the Lower Granite pool were judged to be extremely high because the elutriate ammonia average (3.6 mg/L @ 8.5 pH) could exceed the early life stage criterion three-fold if sediments are suspended. The elutriate ammonia could also exceed both acute criterions (2.14 mg/L and 3.20 mg/L). Potential effects upon ammonia in the Little Goose, Lower Monumental, and Ice Harbor pools were judged to be moderate because the elutriate ammonia average could exceed the chronic early life stage criterion. Monitoring of ammonia concentrations would be conducted during construction to minimize potential effects. Elutriation of manganese could cause a very minor localized effect of lower dissolved oxygen in the immediate area of the discharge. Prior to the start of construction, sediment would be analyzed for mercury and elutriation. Elutriation of zinc in the sediments has the potential to surpass the acute condition criteria for rainbow trout (EPA, 1976). This poses a moderate or higher risk to fish. Monitoring would be conducted to minimize the potential effect. Elutriation of copper located in the sediments has the potential to surpass the acute condition criteria for rainbow trout (EPA, 1976). This also poses a moderate or higher risk to fish. Monitoring would also be conducted to minimize potential effects. If monitoring is conducted for the occurrence of the various contaminants and appropriate actions are taken in response to the results, the cumulative effects of proposed Corps' discharges should not pose an irreversible loss of valuable aquatic resources.

Prediction of effects upon contaminants resulting from potential future Corps' discharges associated with maintenance dredging for navigation, maintenance dredging to keep port basins and boat basins open and accessible, maintenance dredging at public recreation areas, and dredging to maintain irrigation intakes, is extremely difficult. Estimation of the degree and duration of future effects is virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts from contaminants would be imposed, as has been done for the proposed action. Sampling and monitoring would be necessary to determine contaminants present and facilitate assessment of potential risks. If monitoring and sampling were not conducted, the level of risk would not be known. Absent monitoring and sampling for Corps' proposed and potential future actions, cumulative adverse contaminant impacts could be significant.

Other discharges associated with potential future maintenance of irrigation intakes for agriculture, highway and railroad embankment repairs, and bridge repair and/or replacement could have minor to major impacts on contaminants. Prediction of effects from these activities upon contaminants is extremely difficult. Estimation of the degree and duration of future effects for these actions is also virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts upon the substrate would be imposed, as has been done for the Corps' proposed action. If actions to minimize these potential effects were implemented, the cumulative effect of the Corps' proposed and future discharges as well as repairs to irrigation intakes and rail and highway embankment and bridges should not result in major impairment of the water resources and interfere with the productivity and water quality of the existing aquatic ecosystem of the Snake River. Absent implementation of actions to minimize impacts resulting from the non-Corps potential future discharges, significant cumulative effects would likely result.

3.8.3.6 Cumulative Aquatic Ecosystem and Organisms Effects

Determination of the effects of the discharges of dredged and fill material upon the aquatic ecosystem and organisms ranged from "no effect," to "minor," "negligible," "insignificant," and "localized short-term." Additionally, potential chemical and physical effects from ammonia in the Lower Granite pool were judged to be extremely high because the elutriate ammonia average (3.6 mg/L @ 8.5 pH) could exceed the early life stage criterion three-fold. The elutriate could also exceed both acute criterions (2.14 mg/L and 3.20 mg/L). Potential impacts upon ammonia in the Little Goose, Lower Monumental, and Ice Harbor pools were judged to be moderate because the elutriate ammonia average could exceed the chronic early life stage criterion. Actions to minimize effects in the form of monitoring would be implemented and appropriate action taken in response to the data.

Prediction of effects upon the aquatic ecosystem and organisms resulting from potential future Corps' discharges associated with maintenance dredging for navigation, maintenance dredging to keep port basins and boat basins open and accessible, maintenance dredging at public recreation areas, and maintenance dredging irrigation intakes, is extremely difficult. Estimation of the degree and duration of future effects is virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts upon the aquatic ecosystem and organisms would be imposed, as has been done for the proposed action. Sampling and monitoring would be necessary to determine contaminants present and facilitate assessment of potential risks. If monitoring and sampling were not conducted, the level of risk would not be known. Absent monitoring and sampling for Corps' potential future actions, cumulative adverse effects from proposed and potential discharges upon the aquatic ecosystem and organisms could be significant.

Other discharges associated with potential future maintenance of irrigation intakes for agriculture, highway and railroad embankment repairs, and bridge repair and/or replacement could have minor to major impacts on the aquatic ecosystem and organisms. Prediction of effects from these activities is difficult. Estimation of the degree and duration of future effects for these actions is also virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts upon the aquatic ecosystem and organisms would be imposed, as has been done for the Corps' proposed action. If actions to minimize these potential effects were implemented, the cumulative effect of the Corps' proposed and future discharges as well as repairs to irrigation intakes and rail and highway embankment and bridges should not result in major impairment of the water resources and interfere with the productivity and water quality of the existing aquatic ecosystem of the Snake River. Absent implementation of actions to minimize impacts resulting from the non-Corps potential future discharges, significant cumulative effects upon the aquatic ecosystem and organisms would likely result.

3.8.3.7 Cumulative Effects upon Human Use Characteristics

Determination of the effects of the Corps' proposed discharges of dredged and fill material upon human use characteristics ranged from "no effect," to "minor," "negligible," and "localized short-term." Prediction of effects upon human use characteristics resulting from potential future Corps' discharges associated with maintenance dredging for navigation, maintenance dredging to keep port basins and boat basins open and accessible, maintenance dredging at public recreation areas, and maintenance dredging irrigation intakes, is extremely difficult. Estimation of the degree and duration of future effects is virtually impossible when the scope and frequency of the actions are unknown; however, it is reasonable to anticipate that actions to minimize potential impacts upon human use characteristics would be imposed,

as has been done for the proposed action. If actions to minimize effects were implemented, the cumulative effect of proposed and future discharges would likely be non-existent or minor, based on the anticipated predominance of predicted no effect, minor, negligible, and localized short-term effects of the various proposed actions. Absent implementation of any actions to minimize impacts resulting from potential future discharges, significant cumulative effects upon human use characteristics could occur in the future.

Other discharges associated with potential future maintenance of irrigation intakes for agriculture, highway and railroad embankment repairs, and bridge repair and/or replacement could have minor to major impacts on human use characteristics. Prediction of effects from these activities is extremely difficult. Estimation of the degree and duration of future effects for these actions is also virtually impossible when the scope and frequency of the actions are unknown. Non-Corps discharges would be subject to permit requirements under Section 404 of Clean Water Act. Therefore, it is reasonable to anticipate that actions to minimize potential impacts upon human use characteristics would be imposed, as has been done for the Corps' proposed action. If actions to minimize these potential effects were implemented, the cumulative effect of the Corps' proposed and future discharges as well as repairs to irrigation intakes and rail and highway embankment and bridges should not result in irreversible impacts upon human use characteristics. Absent implementation of actions to minimize impacts resulting from the non-Corps potential future discharges, significant cumulative effects on human use characteristics would likely result.

3.9 Determination of Secondary Effects on the Aquatic Ecosystem

3.9.1 Substrate

Presence of the RSWs, BGSs, and SBCs would provide additional habitat for attachment or occupancy by benthic organisms. Some benthic organisms that may attach to the hard structure of the RSWs may be disturbed or destroyed by operation of the structure.

3.9.2 Water Salinity, Circulation, and Fluctuation

No secondary effects upon water salinity, circulation, and fluctuation are anticipated.

3.9.3 Current Patterns and Flow

Operation of the RSWs, BGSs, and SBCs would create intentional, minor, localized alterations in current patterns and flow. The alterations are an intended result for facilitating passage of juvenile salmon through the lower Snake River dams. Pier nose extensions and added and modified deflectors would provide beneficial secondary impacts on current patterns by diminishing the mixing of water that passes through the spillway, thereby, reducing potential increases in TDG.

3.9.4 Suspended Particulates and Turbidity

No secondary effects on suspended particulates and turbidity are anticipated.

3.9.5 Contaminants

The presence and operation of the multiple proposed structures is not expected to cause secondary impacts upon existing contaminants that may be present in the lower Snake River. Operation and maintenance of the RSWs would increase the potential for the release of lubricants into the Snake River.

Operation of barges in the vicinity of the moorage cells and barge access area at Lower Granite would increase the potential for the release of lubricants and fuels.

3.9.6 Aquatic Ecosystem and Organisms

The presence and operation of the various structures would provide beneficial secondary effects upon the aquatic ecosystem through improved passage and survival of juvenile salmonids through the lower Snake River dams.

3.9.7 Human Use Characteristics

Future beneficial economic and recreational impacts could occur as secondary effects in response to potential future improved juvenile passage through the lower Snake River.

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4. Summary of Compliance with 404(b)(1) Guidelines

4.1 Alternatives Test

Based on the discussion in Section 2.4, there are available, practicable alternatives having less adverse impact on the aquatic ecosystem and without other significant adverse environmental consequences that do not involve discharges into "waters of the United States" or at other locations within these waters?
(   )Yes (X)No

Based on Section 2.4, if the project is in a special aquatic site and is not water dependent, are there reasonable and practicable sites available? (   )Yes (   )No (X)NA (Project is water dependent)

4.2 Special Restrictions

Will the discharge:

- Cause or contribute to violations of any state water quality standard? (   )Yes (X)No
- Violate toxic effluent standards? (   )Yes (X)No
- Jeopardize endangered or threatened species or their critical habitat? (   )Yes (X)No

  NMFS' December 21, 2000, Biological Opinion concluded that the impacts of the FCRPS jeopardize the continued existence of listed Snake River salmon. NMFS also included a reasonable and prudent alternative the agency believed would avoid jeopardy.
- Violate standards set by the Department of Commerce to protect marine sanctuaries?
  (   )Yes (X)No

4.3 Evaluation and Testing

Evaluation of the information in Section 3.5 above indicates that the proposed discharge material meets testing exclusion criteria for the following reason(s):

(   ) Based on the above information, the material is not a carrier of contaminants [Subpart G 230.60(a)].
(   ) The levels of contaminants are substantially similar at the extraction and disposal sites and the discharge is not likely to result in degradation of the disposal site and pollutants will not be transported to less contaminated areas 230.60(c).
(X) Acceptable constraints are available and will be implemented to reduce contamination to acceptable levels within the disposal site and prevent contaminants from being transported beyond the boundaries of the disposal site 230.60(d).

4.4 Other Restrictions

Will the discharge contribute to significant degradation of "waters of the United States" through adverse impacts to the following:

Human health or welfare, through pollution of municipal water supplies, fish, shellfish, wildlife or special aquatic sites? ( )Yes (X)No

Life stages of aquatic life or other wildlife? ( )Yes (X)No

Diversity, productivity, and stability of the aquatic ecosystem, such as loss of fish or wildlife habitat or loss of the capacity of wetland to assimilate nutrients, purify water, or reduce wave energy?
( )Yes (X)No

Recreational, aesthetic, or economic values? ( )Yes (X)No

4.5 Actions to Minimize Potential Adverse Impact (Mitigation)

Will all appropriate and practicable steps be taken to minimize the potential adverse impacts of the discharge on the aquatic ecosystem? (X)Yes ( )No

The following appropriate and practicable measures would be included to minimize potential adverse impacts of the discharge on the aquatic ecosystem:

1. Sidecast dredged material would be confined to areas immediately adjacent to the excavation site to minimize transport distance of the material and minimize the footprint of the discharge.
2. Excavation would be held to the necessary minimum to lessen impacts to the substrate.
3. Pre-cast concrete would be adequately cured before placement in the water.
4. Cast-in-place concrete would be placed within tightly sealed forms.
5. One YSI 6600 upg® sonde would be placed in the forebay and one YSI 6600 upg® sonde would be placed at the turbine exit of the dam to assess the accuracy of the predicted impacts for RSWs and SBCs as it relates to salinity. An estimated two sondes would be placed downstream, four sondes alongside, and two sondes upstream of BGSs to assess the accuracy of the prediction as it relates to salinity and the BGSs. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the pier nose extensions to assess the accuracy of the prediction as it relates to pier nose extensions. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the moorage cells and barge access area to assess the accuracy of the prediction as it relates to salinity, the moorage cells, and barge access area. Sondes would collect pH, conductivity, and depth. Backup instrumentation would be on standby at all times. Alkalinity, hardness, and calcium ion analysis would be conducted by titration before, during, and after construction. Flame photometry or ISE electrodes would be used to measure sodium and potassium. Sulfate ion would be measured by turbidimetric analysis and fluoride ion concentration would be measured by ISE to determine their contribution to salinity changes. The data would be provided to Ecology, if requested.
6. Water samples would be collected and analyzed for ions and cations before, during, and after construction of moorage cells and the barge access area to assess the accuracy of the predicted impact upon salinity.
7. Washed gravel, used as fill material in construction of moorage cells and the barge access area, would be obtained from a local gravel source to reduce the potential for incorporation of materials having elevated levels of salts and, thereby, minimize potential impacts to salinity and conductivity.

8. Water samples would be collected and analyzed for ions and conductivity before, during, and after construction of pier nose extensions to identify effects of accidental releases of wet concrete into the water column and to identify remedial actions.
9. Actions such as controlling the amount and duration of discharge, minimizing discharges, and performing work in the winter months would be utilized to minimize impacts to water chemistry. Water samples would be collected and analyzed for changes in water chemistry before, during, and after construction of the RSWs, BGSs, SBCs, pier nose extensions, moorage cells, and barge access area to assess accuracy of the associated predicted impacts.
10. Water samples would be collected and analyzed for clarity, color, organic nitrogen, phosphorus parameters, and ions before, during, and after construction of RSWs, BGSs, pier nose extensions, barge moorage cells, and barge access area to assess accuracy of the predicted impact.
11. Sediment samples would be collected and analyzed for ammonia before, during, and after construction of RSWs, BGSs, SBCs, pier nose extensions, moorage cells, and barge access area to assess accuracy of the predicted impact.
12. One YSI 6600 upg® sonde would be placed in the forebay and one YSI 6600 upg® sonde would be placed at the turbine exit of the dam to assess the accuracy of the prediction for RSWs and SBCs as it relates to turbidity. An estimated two sondes would be placed downstream, four sondes alongside, and two sondes upstream of BGSs to assess the accuracy of the prediction as it relates to turbidity and the BGSs. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the pier nose extensions to assess the accuracy of the prediction as it relates to pier nose extensions. One sonde would be placed in the forebay and 12 sondes would be placed in a grid array downstream of the moorage cells and barge access area to assess the accuracy of the prediction as it relates to turbidity, the moorage cells, and barge access area. Sondes would collect turbidity and depth 24 hours per day, 7 days per week. Backup instrumentation would be on standby at all times. Secondary readings would be taken using a Hach 2100 P nephelometer for QA/QC. The data would be provided to Ecology, if requested.
13. Turbidity would be monitored 300 feet downstream of the dam during in-water excavation and discharge activities associated with construction of RSWs, BGSs, SBCs, sheet pile barge moorage cells, and the barge access area. In compliance with WAC 173 201A-030, if, during in-water excavation and discharge activity, turbidity levels at the monitoring site exceed 5 NTUs over background turbidity when the background turbidity is 50 NTUs or less; or, if turbidity levels at the monitoring site increase by more than 10 percent when the background turbidity is more than 50 NTUs, in-water excavation and discharge activity would temporarily cease until turbidity levels at the monitoring site returned to levels within these limits.
14. Monitoring of ammonia concentrations would be conducted during construction to assess the accuracy of predicted impacts. If, during discharge activities, ammonia levels at monitoring sites exceed state and Federal limits, discharge activities would temporarily cease until ammonia levels at monitoring sites return to levels within state and Federal limits.
15. Sediment samples would be collected and analyzed for DDT before construction of RSWs, BGSs, barge moorage cells, and the barge access area to determine the presence of DDT. Where DDT is found above the screening level or elutriate value, the specific material would be taken to an approved upland disposal site.
16. Prior to the start of construction, sediment would be analyzed for mercury and elutriation. If mercury were found to be present, elutriated sediments and dissolved mercury in the water would be monitored. If mercury levels exceed the Freshwater Criteria (EPA, 1985b) of 0.012 μg/L for 4 days with a 2.4 μg/L per 1 hour maximum average, work would be halted and consultation would be conducted with appropriate state and Federal agencies.

17. Prior to the start of construction, sediment would be analyzed for zinc and elutriation and water would be analyzed for hardness. Elutriate would be analyzed to determine if an acute or chronic condition is created for specific species of fish that may be present during construction. If a chronic or acute condition were identified, additional bioassay analysis would be conducted.
18. Prior to the start of construction, sediment would be analyzed for copper and elutriation, and water would be analyzed for hardness. Elutriate would be analyzed to determine if an acute or chronic condition is created for specific species of fish that may be present during construction. If a chronic or acute condition were identified, additional bioassay analysis would be conducted.
19. Wet concrete used to construct pier nose extensions would be discharged into tightly sealed forms.
20. Pre-cast concrete discharged as fill material would be adequately dried prior to placement in the water.
21. Gravel discharged into the constructed moorage cells and behind the sheet pile wall of the barge access area would be washed of any silts and soils prior to placement to minimize the potential introduction of contaminants.
22. All in-water work would be conducted during the standard in-water work window of December 15 through March 1 to minimize impacts upon Federally listed anadromous species, unless coordinated with resource agencies.
23. The general construction area of the reservoir for the barge moorage cells and barge access area at Lower Granite would be signed to restrict access to boaters for public safety. Access restrictions would be removed immediately upon completion of construction to allow resumption of recreational fishing activity.
24. Actions identified in Section 3.4.4 to minimize impacts related to turbidity would also minimize potential impacts of turbidity related to mixing zone and upon aesthetics.

5. Determination of Compliance/Non-compliance of the Recommended Plan (Preferred Alternative)

( ) The discharge complies with the guidelines.

(X) The discharge complies with the guidelines, with the inclusion of the appropriate and practicable conditions listed above in Section 4.5 to minimize pollution or adverse effects to the affected ecosystem.

( ) The discharge fails to comply with the requirements of these guidelines because:

- ( ) there is a practicable alternative to the proposed discharge that would have less adverse effect on the aquatic ecosystem and that alternative does not have other significant adverse environmental consequences.
- ( ) the discharge will result in significant degradation of the aquatic ecosystem under 40 CFR 230.10(b) or (c).
- ( ) the discharge does not include all appropriate and practicable measures to minimize potential harm to the aquatic ecosystem.
- ( ) there is not sufficient information to make a reasonable judgment as to whether the proposed discharge will comply with the guidelines.

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6. Literature Cited

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7. Glossary

Acute: A sudden onset or sharp-rise response from toxicity due to a contaminant that exhibits a toxic effect on aquatic animals. This term may also be directly associated with published LD 50 or LC 50 dose rates. (See LC 50 and LD 50)

Aesthetics: Of or pertaining to the sense of the beautiful.

Amictic: In rotifers, producing diploid eggs that are incapable of being fertilized.

Anadromous fish: Fish, such as salmon or steelhead trout, that hatch in freshwater, migrate to and mature in the ocean, and return to freshwater as adults to spawn.

Anion: A negatively charged ion.

Anthropogenic: Changes made by human activity.

Behavioral guidance structure (BGS): Long, steel, floating structure designed to simulate the natural shoreline and guide fish toward the surface bypass collection system by taking advantage of their natural tendency to follow the shore.

Benthic community: Aquatic organisms and plants that live on the bottom of lakes or rivers, such as algae, insects, worms, snails, and crayfish. Benthic plants and organisms contribute significantly to the diets of many reservoir fish species.

Benthivore: An organism that consumes bottom-dwelling organisms.

Biota: The animal and plant life of a particular region considered as a total ecological entity.

Cation: A positively charged ion.

Centrarchid: Centrarchid is a colloquial term for the spiny-ray fishes of the Centrarchidae family.

Chironomid: An insect, midge, which has a benthic larval stage.

Cladocera: An order of small, freshwater branchiopod crustaceans, commonly known as water fleas.

Chlorophyll *a*: A green plant pigment necessary for plants to produce carbon from sunlight.

Comp Plan: Plan for compensation of fish and wildlife losses resulting from construction of the four lower Snake River dams. Environmental Impact Statement - Lower Snake River Fish and Wildlife Compensation, 1976.

Copepod: Any of various small marine and freshwater crustaceans of the order *Copepoda.*

Dam breaching: In the context of this FR/EIS, dam breaching involves removal of the earthen embankment section at Lower Granite and Little Goose Dams and formation of a channel around Lower Monumental and Ice Harbor Dams.

Diploid: Having a homologous pair of chromosomes for each characteristic except sex, the total number of chromosomes being twice that of a gamete.

Dissolved gas supersaturation: Caused when water passing through a dam's spillway carries trapped air deep into the waters of the plunge pool, increasing pressure and causing the air to dissolve into the water. Deep in the pool, the water is "supersaturated" with dissolved gas compared to the conditions at the water's surface.

Drawdown: In the context of this document, drawdown means returning the lower Snake River to its natural, free-flowing condition via dam breaching.

Eluate: Type of water sample created by mixing sediment and water.

Endangered species: A native species found by the Secretary of the Interior to be threatened with extinction.

Entrainment: The movement of an organism downstream out of a reservoir due to discharges from dam operations.

Eutrophic: A body of water in which the increase of mineral and organic nutrients reduces dissolved oxygen, producing an environment that favors plant over animal life.

Extended submerged bar screen (ESBS): Screens extending in front of the turbines to guide fish away from the turbines and up to the juvenile fish collection channel inside the dam. These are an alternative to the submerged traveling screens.

Fauna: Animals collectively, especially the animals of a particular region or time.

Fecal coliform bacteria: A group of organisms belonging to the coliform group and whose presence denotes recent fecal pollution from warm-blooded animals.

Federal Columbia River Power System: Official term for the 14 Federal dams on the Columbia and Snake rivers.

Fish collection/handling facility: Holding area where juvenile salmon and steelhead are separated from adult fish and debris by a separator and then passed to holding ponds or raceways until they are loaded onto juvenile fish transportation barges or trucks.

Flora: Plants collectively; especially the plants of a particular region or time.

Flow augmentation: Increasing river flows above levels that would occur under normal operation by releasing more water from storage reservoirs upstream.

Foraging habitat: Areas where wildlife search for food.

Forebay: The area of water directly upstream of a dam.

Freshet: A sudden overflow of a stream resulting from a heavy rain or thaw.

Gas chromatograph mass spectrometer: An analytical device used in the detection and quantification of organic compounds that have a degree of volatility and provide a distinct chromatogram.

Haploid: Having half of the diploid or full complement of chromosomes, as in mature gametes.

Hydrology: The science dealing with the continuous water cycle of evapotranspiration, precipitation, and runoff.

Impoundment: Accumulated water in a reservoir.

Inundation: The covering of pre-existing land and structures by water.

Irrigation: Artificial application of water to usually dry land for agricultural use.

Juvenile fish transportation system: System of barges and trucks used to transport juvenile salmon and steelhead from the lower Snake River or McNary Dam to below Bonneville Dam for release back into the river; alternative to in-river migration.

Kjeldahl nitrogen: The sum of organic nitrogen and ammonia nitrogen.

Lacustrine: Of or pertaining to a lake.

Larva/larvae: An early life stage of an animal.

LC 50: The median lethal concentration, that is the concentration (expressed as ppm or ppb) of a toxicant to the environment (usually water) that produces a designated effect (most often measured as death) to 50 percent of the population of test organisms exposed. These tests are used to determine acute environmental health and safety limits of chemicals but do not necessarily measure chronic effects.

LD 50: The median lethal dose, that is the milligrams of a toxicant per kilogram of body weight that is lethal to 50 percent of the test animals to which it is administered under the conditions of an experiment. It is sometimes referred to as experimental dose or experimental LD 50.

Limnology: The study of the physical, chemical, and biological aspects of rivers, lakes, or reservoirs. It is derived from the Greek word "limnos" which pertains to lake of freshwater. A limnologist in freshwater science is analogous to the marine biologist in saltwater science.

Lower Snake River Project: The name for the Corps' four lower Snake River facilities combined.

Macroinvertebrate: Organism without a backbone generally measuring more than 0.5 to 1 mm in size.

Mictic: Of or pertaining to eggs which, without fertilization, develop into males and, with fertilization, develop into amictic females, as occurs in rotifers.

Mollusk: Any member of phylum Mollusca, largely marine invertebrates.

National Environmental Policy Act (NEPA): An act, passed by Congress in 1969, that declared a national policy to encourage productive harmony between humans and their environment, to promote efforts that will prevent or eliminate damage to the environment and the biosphere, to stimulate the health and welfare of humans, to enrich the understanding of the ecological systems and natural resources important to the nation, and to establish a Council on Environmental Quality. This act requires the preparation of environmental impact statements for Federal actions that are determined to be of major significance.

Navigation: Method of transporting commodities via waterways; usually refers to transportation on regulated waterways via a system of dams and locks.

Nekton: Free swimming aquatic animals that normally move about their environment independent of current and wave action.

Overwinter: To spend or survive the winter.

Parthenogenic: Produced by a special type of sexual reproduction (common among rotifers) in which an egg develops without entrance of a sperm.

pH: A logarithmic index of the hydrogen ion concentration in water, measured on a scale of 0 to 14. A value of 7 indicates a neutral condition; values less than 7 indicate acidic conditions, and values greater than 7 indicate alkaline conditions.

Phytoplankton: Drifting plants such as microscopic algae that nourish themselves from the energy of the sun; they are at the base of the food chain and provide a food source for bacteria, water molds, and zooplankton.

Piscivorous: Feeding on fishes.

Planktivorous: Feeding on planktonic organisms.

Photoperiod: The light period during which conditions are satisfactory for active photosynthesis in aquatic plants and algae.

Poikilothermic: An organism that does not have to maintain a constant body temperature to process its metabolic pathways.

Pumping stations: Facilities that draw water through intake screens in the reservoir and pump the water uphill to corresponding distribution systems for irrigation and other purposes.

Removable spillway weir (RSW): A removable steel structure that is attached to the forebay of an existing spill bay, creating a raised overflow weir above and upstream of the existing spillway crest.

Resident fish: Fish species that reside in freshwater throughout their lifecycle.

Riparian: Ecosystem that lies adjacent to streams or rivers and is influenced by the stream and its associated groundwater.

Riprap: A permanent, erosion-resistant groundcover constructed of large, loose, angular, or subangular rounded stone.

Rotifer: Any of various minute multicellular aquatic organisms of the phylum Rotifera, having at the anterior end a wheel like ring of cilia.

Salmonid: Of or belonging to the family Salmonidae, which includes salmon, trout, and whitefishes.

Spill: Water released through the dam spillways, rather than through the turbines. Involuntary spill occurs when reservoirs are full and flows exceed the capacity of the powerhouse or power output needs. Voluntary spill is one method used to pass juvenile fish without danger of turbine passage.

Spillbay: One of the eight openings in the entire spillway. Water passes over each spillbay.

Stilling basin: A concrete-lined pool below the dam where water dissipates energy prior to flowing downstream.

Submerged traveling screens: Structures with a moving (traveling) screen extending in front of the turbines to guide fish away from the turbines, up to the juvenile fish collection channel inside the dam. These are an alternative to the extended submerged bar screens.

Substrate: Substances used by organisms for growth in a liquid medium; surface area of solids or soils used by organisms to attach.

Surface bypass collection (SBC) system: System designed to divert fish at the surface before they have to dive and encounter the existing turbine intake screens. SBCs direct the juvenile fish into the forebay, where they are passed downstream either through the dam spillway or via the juvenile fish transportation system of barges and trucks.

Tailrace: The canal or channel that carries water away from a dam.

Tailwater: The water surface immediately downstream from a dam.

Threatened species: A native species likely to become endangered within the foreseeable future. **Total Maximum Daily Load (TMDL):**

Total suspended solids (TSS): The portion of the sediment load suspended in the water column. The grain size of suspended sediment is usually less than one millimeter in diameter (clays and silts). High TSS concentrations can adversely affect primary food production and fish feeding efficiency. Extremely high TSS concentrations can impair other biological functions such as respiration and reproduction.

Toxic equivalent: A scaled value used to determine the toxic capacity of a series of related compounds in various concentrations in comparison to the primary toxic constituent.

Turbidity: An indicator of the amount of sediment suspended in water. It refers to the amount of light scattered or absorbed by a fluid. In streams or rivers, turbidity is affected by suspended particles of silts and clays, and also by organic compounds like plankton and microorganisms. Turbidity is measured in Nephalometric Turbidity Units.

Wetland: An ecosystem in which groundwater saturates the surface layer of soil during a portion of the growing season, often in the absence of surface water. This water remains at or near the surface of the soil layer long enough to induce the development of characteristic vegetative, physical, and chemical conditions.

Zooplankton: Tiny, floating animals that provide a food source for larger aquatic organisms such as snails and small fish.

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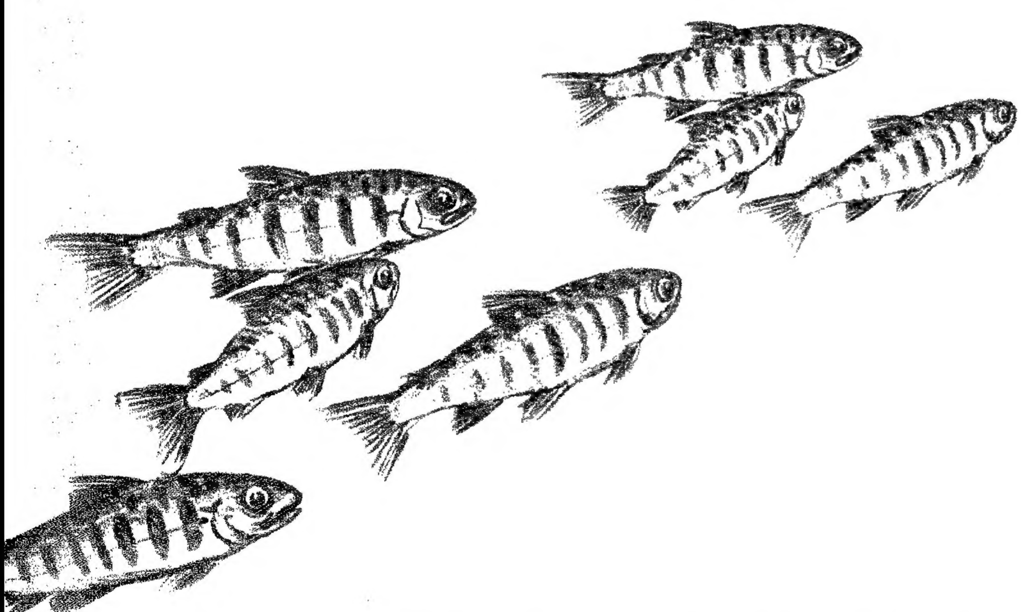

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